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TP 4429E

SLURRY PIPELINE DESIGN MANUAL - PHASE I

Prepared for

Transportation Development Centre

by W.H.W. Husband, R. Gillies, M. Small

Saskatchewan Research Council

C.A. Shook

University of Saskatchewan

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SASKATCHEWAN RESEARCH COUNCIL

TP 4429E

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by

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Transport Canada/Transports Canada

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Saskatchewan Research Council
Saskatoon

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March, 1983

The contents of this report reflect the views of the contractor and not necessarily the official views or policies of the Transportation Development Centre.

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17. Abstract

This report presents the findings and results of the first phase of a program to prepare a slurry pipeline design engineering manual.

The primary tasks of the first phase were:

- to carry out a literature search and synthesis of references on the subject of slurry pipeline standards, engineering design practice and construction procedures,
- to establish an editorial board,
- to prepare an outline syllabus for a slurry pipeline engineering manual,
- to identify potential authors,
- to establish writing and publishing guidelines to assist authors,
- to identify the most serious knowledge gaps likely to limit the scope of the manual.

These tasks have been completed and the results are discussed in the body of this report and summarized in appendices.

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17. Résumé

Ce rapport rend compte du résultat de la phase I du programme visant l'élaboration d'un guide touchant le calcul des pipelines pour le transport de matières solides.

Les objectifs fixés à ces travaux ont été les suivants:

- faire une recherche documentaire et dresser une bibliographie sur le sujet: normes, paramètres de calcul et méthodes de construction;
- définir la composition du comité de rédaction;
- esquisser le plan de l'ouvrage;
- dresser une liste des rédacteurs éventuels;
- établir des lignes directrices sur la rédaction et la publication de l'ouvrage envisagé et susceptibles d'aider les rédacteurs dans leur tâche;
- cerner les lacunes dans les connaissances de nature à restreindre la portée du guide.

Ces objectifs ayant été atteints, les résultats sont repris dans le rapport et récapitulés sous forme d'annexes.

18. Mots-clés	19. Diffusion
Stéréoducs, transport hydraulique, guide de calcul, méthodes de construction	Le CDT dispose d'un nombre limité d'exemplaires

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SUMMARY

This report presents the findings and results of the first phase of a program to prepare a slurry pipeline design engineering manual.

The primary tasks of the first phase were:

- to carry out a literature search and synthesis of references on the subject of slurry pipeline standards, engineering design practice and construction procedures,
- to establish an editorial board,
- to prepare an outline syllabus for a slurry pipeline engineering manual,
- to identify potential authors,
- to establish writing and publishing guidelines to assist authors,
- to identify the most serious knowledge gaps likely to limit the scope of the manual.

A literature search was made of the data bases COMPENDEX, ENVIROLINE, NTIS and PROMT to determine previous work relating to slurry pipeline manuals. Abstracts of the retrieved documents have been listed in an appendix.

From their knowledge of the existing expertise in Canada for slurry pipelines, the authors identified seven people with suitable experience in the field of slurry pipelining to be members of an editorial board for the manual. These people were approached and all have indicated willingness to serve on the board.

The senior author prepared a draft outline syllabus and circulated it to the seven candidates for the editorial board. At a subsequent telephone conference with these candidates, the draft syllabus was discussed in detail and then revised on the basis of the discussion. The syllabus is presented in an appendix and the rationale for inclusion of each chapter is described.

Potential authors for each chapter were proposed by the authors of this report. None of the potential authors has been approached to determine his willingness to contribute to the manual.

Guidelines for writing and publishing the manual were established by the senior author and essentially are those used for the TDC's proposed textbook Fundamentals of Urban Transit.

Future R&D needs were reviewed by the authors, in light of their knowledge of the field of slurry transport, and a priorized listing of specific needs was developed.

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1. INTRODUCTION

1.1 Background

In 1960 the Saskatchewan Research Council (SRC) recognized the potential of pipelines to transport solid materials over long distances in Canada to markets. Potash had been discovered in large quantities in Saskatchewan. However, markets were 700 to 1500 km distant. Rail freight rates amounted to as much as 50% of the final cost of potash to the consumer.

Against such a background, an attempt was made to determine the technical and economic feasibility of potash pipelines from Saskatchewan to Vancouver and the Chicago area. Lack of adequate basic engineering design data soon became apparent and a decision was made to initiate a study of the hydraulic transport of solids through pipelines. Staff of SRC and the University of Saskatchewan collaborated to construct and operate a small experimental pipeline loop in 1961.

By the end of 1965 experimental work on larger diameter pipeline loops was required to verify or modify the design equations developed from the measurements on the original 50 mm loop. Fortuitously, in 1966 the Interprovincial Steel and Pipe Corporation of Regina sponsored a three year study of potash pipelining at SRC under the PAIT program of the Department of Industry, Trade and Commerce. During this period a building with 800m^2 floor space was acquired and pipeline loops with diameters of 150 mm, 200 mm, 250 mm, 300 mm and 350 mm were constructed and operated.

In 1970 the Canadian Transport Commission (CTC) awarded a contract to SRC to undertake a three year program to provide background information for the development of slurry pipelines in Canada. The objectives of the program were to:

1. provide the CTC and the Canadian public with appropriate technical information for the design of slurry pipelines.
2. encourage the consolidation of a Canadian team which could undertake meaningful, large scale research and development for the design of slurry pipelines.
3. provide universities and consulting engineering firms with basic data with which they could develop better models of the physical phenomena involved in transporting suspensions of solids in pipelines.

Late in the program the federal government transferred coordinating responsibilities to the Transportation Development Agency in the Ministry of Transport. This agency, now called the Transportation Development Centre (TDC), has been guiding the SRC's Slurry Pipeline Development Centre at Saskatoon through the use of a steering committee composed of members from government and industry. Since 1976 the Slurry Pipeline Development Centre has been operating almost exclusively on contracts with industry.

The initial cooperation between SRC and the University of Saskatchewan has continued through the years and has been a vital part contributing to the success of the Centre. In general, theoretical studies have been undertaken by graduate students under the direction of the Department of Chemical Engineering of the University while design, construction and operation of experimental pipeline loops have been carried out by engineers and technologists of SRC. Approximately 100 reports have been issued.

The research and development work over such an extended period of time, coupled with the industrial contracts, has developed a centre of excellence both intellectually and in the form of facilities for slurry pipeline research. The current staff at SRC and Professor Shook at the University of Saskatchewan are recognized internationally as an outstanding team in the field of pipeline transportation of solids. This team is the basis for Canada being designated the lead agency through CANMET for two tasks on coal pipelines by the International Energy Agency. Lately, oil companies in the United States have begun to use the team and its facilities for heavy crude oil and shale oil pipeline applications.

1.2 Purpose of Project

TDC believes the time has come to consolidate the work done on slurry pipeline research into a practical design manual for engineers engaged in the planning, design and evaluation of slurry pipelines in Canada. The preparation of such a manual would provide a complete up to date reference book on the subject and at the same time would identify areas of uncertainty in the basic engineering background. A rational review of these deficiencies could be done to priorize them and to develop a future research, development and demonstration program. Thus the way would be established to ensure maximum technology transfer and cost effectiveness in the design and construction of slurry pipelines by Canadian firms.

To initiate such a program, TDC awarded a contract to SRC in November, 1982, to undertake the first phase of a project to prepare a slurry pipeline design manual. The purpose of the first phase is to prepare a syllabus for the manual, establish an editorial board, set writing and publishing guidelines, identify potential authors, and to determine the most serious knowledge gaps likely to limit the scope of the manual.

2. LITERATURE REVIEW

A literature search was undertaken to determine previous work relating to slurry pipeline manuals. SRC's library made on line searches of five databases and retrieved abstracts for 112 documents. The databases were COMPENDEX, ENVIROLINE, ISMEC, NTIS, and PROMT. The key points for these systems are given in Table 1.

Database	Publisher	Printed Equivalent	Fields	Coverage
COMPENDEX	Engineering Index Inc. New York	Engineering Index Monthly	All aspects of engineering, books, reports, conference proceedings, standards, 3000 journals.	January 1970 - present monthly updates
ENVIROLINE	Environment Information Center, Inc. New York	--	World's environmental information	1971 - present monthly updates
ISMEC (Information Service in Mechanical Engineering)	Cambridge Scientific Abstracts Bethesda, MD	--	All aspects of mechanical engineering, books, reports, conference proceedings, 200 journals	1973 - present monthly updates
NTIS	National Technical Information Service Springfield, Virginia	Government Reports Announcements and Index	Science and Technology. Reports from over 300 US Federal Agencies	January 1971 - present monthly updates
PROMT (Predicasts overview of Markets and Technology)	Predicasts, Inc. Cleveland, Ohio	--	Industry	1972 - present weekly updates

Table 1 Details of Databases

Combinations of the following keywords or descriptors were used.

coal	pipeline	instrumentation
solids	designing	
slurry	design	
iron ore	standards	
tailings	construction	

For instance, the searches looked for publications on designing slurry pipeline, solids pipeline, slurry pipeline design, etc. The abstracts of the retrieved documents have been collected in Appendix A.

Surprisingly, not one document could be described as a design manual, or represented construction practices. Although many of the documents present design methods for slurry pipelines or discuss current slurry pipeline technology, they are relatively short and do not cover all aspects of designing, constructing and operating such lines.

A search of the Slurry Pipeline Development Centre's literature system produced two lists of documents which are shown in Appendices B and C. Appendix B lists publications which bear directly on the preparation of a Canadian slurry pipeline manual. Appendix C lists manuals, handbooks, standards and guides for other types of pipelines. These latter publications will be useful as reference works and as background material to the slurry pipeline manual.

3. EDITORIAL BOARD

A manual dealing with such complex technical operations as the planning, design and construction of slurry pipelines must cover a wide range of topics. Therefore an editorial board is required to assist an Editor-in-chief, and to ensure excellence in the presentation for each section of the manual. Board members must be selected on the basis of technical area of expertise, knowledge of the subject, experience, and recognized authority.

As there are few slurry pipelines in Canada, and these are rarely more than a kilometre in length, there are few people in Canada

experienced in all aspects of slurry pipeline operations. So careful consideration had to be given to the selection of suitable candidates for the editorial board. The following persons, representing government, industry, consulting engineering firms, and universities, are recommended for appointment to the board. All persons have indicated willingness to serve on the board.

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Professor Charles has extensive R & D experience with two phase flow in pipelines. After establishing himself in this field at the Alberta Research Council, he moved to the University of Toronto and has been active ever since in slurry pipeline research.

Mr. Erskine has been a principal research engineer with Suntech Engineering for many years. He was involved extensively in the process development, start-up and continued operation of the Fort McMurray plant of the former Great Canadian Oil Sands Company, now called Suncor. Lately he has directed Suncor's R & D program on slurry pipelines.

Mr. Gilbert, until lately, has been the liasion officer of TDC for supervising the projects which SRC has undertaken for TDC. He has been chairperson of the steering committee composed of people from industry and government established to direct these projects.

Mr. McLaughlin has had a long association with the slurry pipeline developments in Canada. He was the original liaison officer for CTC when the federal government began sponsoring slurry pipelining R and D in 1970. His knowledge of the regulatory aspects of commodity pipelines will be extremely valuable to the manual project.

Mr. Oliver has had extensive experience with oil and gas pipelines.

Professor Shook has been involved in slurry pipeline R and D since his graduate studies at Imperial College in the late 50's. He has been an integral part of the SRC - University of Saskatchewan team ever since and has been involved in slurry research projects in Chile, the United Kingdon, India, the United States and Canada.

Dr. St. Denis has had experience in industry and at the Alberta Research Council. Presently, as Director of Research, he is involved in slurry pipeline development at Techman Engineering

4. SYLLABUS

4.1 General

The establishment of a syllabus for the slurry pipeline manual is the major task of the contract and is of utmost importance to the ultimate success of the manual. Because of delays in authorization of the contract, SRC did not begin work until January, 1983. Candidates for the editorial board were contacted during January and

February and then consents to serve on the board were obtained in late February. Therefore, the format and content of a syllabus have been considered by the candidates for less than a month.

4.2 Approach

As the subject of slurry pipelines is broad and complex, a relatively large editorial board is required to assist the editor-in-chief. Thus, consenus on a final syllabus will take time. The initial approach taken to deal with the problem has been to prepare a very rough outline and circulate it to the editorial board candidates for review. On the basis of feedback from the candidates, a more extensive outline was prepared and circulated for review. This latter outline was discussed by the candidates in a 50 minute telephone conference on March 29th and has been revised on the basis of the discussion. The revised syllabus is recorded in Appendix D. Although the present outline might satisfy most editorial board members, a further review and telephone conference discussion is recommended.

4.3 Rationale of Chapters

The introductory chapter has to give the reader an overview of the manual to show him the subject, its importance, and how it has been developed in a logical fashion. The goal of the manual must be clearly defined so the attention of the intended reader is obtained, he can appreciate readily the value of the manual, and is willing to make the effort to pursue his way through it.

Chapter 2 will give examples of successful slurry pipelines to show the method works and to gain the confidence of readers that they are not wasting their time.

Chapter 3 will use the existing background of liquid pipelines to form the basis for going from conventional practice to a new mode of pipelining. Then chapter 4 will give an overview of a complete slurry pipeline system using examples from chapter 2 of existing systems. Chapter 4 will orient the readers to the following Chapters 5 to 9 which deal with the component parts of slurry pipeline design.

Chapter 10 follows up on the previous chapters on design to point out that some of the design procedures are still subject to uncertainties and a certain amount of experimental confirmation is desirable.

Chapters 11 and 12 will deal with standards which designs have to meet, and construction practices which will be used when projects are approved. Chapter 13 will bring in the environmental aspects which must be considered when establishing routes and during construction.

Chapter 14 will discuss the problems of drawing the whole project together and ensuring the provision of information, men and materials to complete the project on time and on budget.

Chapter 15 will use three different types of pipelines to illustrate the costing of pipeline systems to determine economic feasibility.

Chapter 16 will review regulatory aspects of legislation relating to pipelines. Chapter 17 will outline current R & D and establish future priorities.

5. AUTHORS

Selection of appropriate authors is vital to the success of the manual. Each author should be an authority in his field and willing to blend his section of the manual into the overall goal of the project. However, as there are no long distance slurry pipelines operating in Canada and few tailings pipelines of any size, there are few people in Canada qualified as authors for this slurry pipeline manual. If the TDC wishes to maintain 100% Canadian participation, there may well be difficulties with respect to authors.

Time restraints have not permitted the canvassing of potential authors. However, a tentative listing has been made and is summarized in Table 2. These people should be contacted and additional candidates also should be identified and contacted.

Chapter Number	Title	Potential Authors	Affiliation
1	Introduction	W.H.W. Husband	SRC
2	Historical Development of Slurry Pipelines	W.H.W. Husband	SRC
3	Conventional Liquid Pipeline Design	H.G. Oliver	Dynawest Projects Ltd.
4	The Slurry Pipeline System	W.H.W. Husband	SRC
5	Slurry Preparation	D.L. Young C.E. St. Denis and/or F. Webb M. Mikhail	Ingersoll-Rand Co. Techman Engineering CANMET
6	Slurry Pumps	D.L. Young R.J. Prudhomme	Ingersoll-Rand Co. Wilson-Snyder Pumps
7	Slurry Characteristics	C.A. Shook	University of Saskatchewan
8	Slurry Pipeline Design	C.E. St. Denis and/or F. Webb	Techman Engineering
9	Slurry Dewatering	C.E. St. Denis and/or F. Webb D.A. Dahlstrom	Techman Engineering Eimco Process Equipment Co.
10	Value of Pipeline Pilot Plant Work	C.A. Shook W.H.W. Husband	University of Saskatchewan SRC
11	Engineering Standards	C.E. St. Denis and/or F. Webb	Techman Engineering
12	Construction Practices	H.G. Oliver	Dynawest Projects Ltd.
13	Environmental Aspects	C. Wachman	Environment Canada
14	Logistics	W.H.W. Husband	SRC
15	Cost Estimation	C.E. St. Denis and/or F. Webb	Techman Engineering
16	Regulatory Aspects	G.M. McLaughlin	CTC
17	Research and Development	C.A. Shook	SRC

Table 2. Potential Authors for Slurry Pipeline Manual

6. GUIDELINES FOR AUTHORS

As the manual will be prepared on a chapter by chapter basis with different authors for each chapter, there is need for guidelines to promote consistency in style, format, and manuscript preparation. After reviewing TDC's Publication Standards for Contractors, the author's guidelines for the Canadian Transit Handbook, and the author's guide for the proposed textbook Fundamentals of Urban Transit, the decision was made to adopt the last mentioned author's guide in modified form. The modified form is presented in Appendix E.

7. FUTURE R & D

The TDC contract to SRC for the first phase of preparing a slurry pipeline manual required the identification of the most serious knowledge gaps likely to limit the scope of the manual and which require the highest priority for future R & D. This matter has been reviewed in the context of four types of slurry pipeline systems,

- short pipelines with coarse slurries;
- long pipelines with fine slurries;
- long pipelines with non-aqueous carrier fluids;
- in-plant and tailings pipelines

Assuming that the manual will be used by engineers in the metallurgical, chemical and petroleum industries, and in mining companies, as well as by consulting engineering firms, specific areas for R & D have been outlined with appropriate priority rankings. The areas and the applicable type of pipeline are listed in descending order of priority as follows.

1. Particle size distribution influence on pressure gradient.
   Short pipelines with coarse slurries.
2. Deposit velocity prediction.
   Short pipelines with coarse slurries.
3. Pump efficiency relationships.
   Short pipelines with coarse slurries.
4. Wear rates and patterns.
   Short pipelines with coarse slurries.
5. Attrition rates.
   Short pipelines with coarse slurries.

6. Pressure gradients and deposit velocities.
   Long pipelines with non-aqueous carrier fluids.
7. Pressure gradients and deposit velocities vs temperature for tailings and brine slurries.
   In-plant and tailings pipelines.
8. Particle size distribution influence on pressure gradient.
   Long pipelines with fine slurries.
9. Mathematical modelling of slurry flow.
   All pipelines.

APPENDIX A Literature References Pertaining to the Design and Construction of Slurry Pipelines.

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DIALOG File6: NTIS - 64-83/Iss8 (Copr. NTIS) (Item 1 of 20) User 1446 9mar83

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Report on the Assessment of Coal-Slurry Pipelines. Volume II. Appendices
Skelly and Loy, Harrisburg, PA.
Corp. Source Codes: 058545000; 9503032
Sponsor: Systems Consultants, Inc., Washington, DC.; Department of Energy, Washington, DC.
Report No.: DOE-ET
Jun 81 64p
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Languages: English
NTIS Prices: PC A04/MF A01 .
Country of Publication: United States
Journal Announcement: GRAI8307; NSA0700
Contract No.: AC01-79ET11268

This study examines major technical, economic, environmental and logistic aspects of aqueous and non-aqueous coal slurry pipeline systems. Factors affecting slurry preparation, separation and utilization were considered. Transport media included water, methanol, no. 2 fuel oil, and liquid CO sub 2 . Analyses were based on data available in the open literature. Long distance transport systems were considered as well as short distance concepts. System characteristics were analyzed in relation to throughput rate, pipe diameter, coal particle size and transport media. Volume 3 contains appdices as follows: benefits of transporting dried coal; milling power requirements for the different slurries; mixing power requirements; determination of density and viscosity of coal slurries; procedure for pipeline design calculations; Newton's method of equation solving; calculation of critical velocity to prevent deposition; methodology of economic comparison of different fuel slurries in pipelines; list of coal slurry pipeline studies (1972 to 1980) and bibliography. (ERA citation 07:042199)

Descriptors: *Slurry pipelines; *Fuel slurries; Hydraulic transport; Comparative evaluations; Coal; Water; Fuel oils; Methanol; Carbon dioxide; Comminution; Power demand; Density; Viscosity; Measuring methods; Design; Calculation methods; Critical velocity; Economics

Identifiers: ERDA/013000; ERDA/294001; NTISDE

Section Headings: 21D (Propulsion and Fuels--Fuels); 13K (Mechanical, Industrial, Civil, and Marine Engineering--Pumps, Filters, Pipes, Fittings, Tubing, and Valves); 85E (Transportation--Pipeline Transportation); 97K (Energy--Fuels)

951258 PB83-136259
Feedstock Characteristics and Preparation for Peat Gasification. Volume II: Task 9
(Final rept. Jul 80-Jul 81)
Punwani, D. V. ; Aspinall, F. ; Lofton, S. M.
Institute of Gas Technology, Chicago, IL.
Corp. Source Codes: 013602000
Sponsor: Gas Research Inst., Chicago, IL.
Report No.: GRI81/0011.2
Jul 82 250p

See also PB81-222275, Volume 1, PB83-136242, and Volume 3, PB83-136267. Prepared in cooperation with Dravo Corp., Pittsburgh, PA., and Williams Bros. Engineering CO., Tulsa, OK.

Also available in set of 3 reports PC E99, PB83-136234.
Languages: English
NTIS Prices: PC A11/MF A01
Country of Publication: United States
Journal Announcement: GRAI8306
Contract No.: GRI-5014-310-0256; IGT-30531

This report describes the work conducted by the Institute of Gas Technology, Dravo Corporation, and Williams Brothers Engineering Company during Phase II of the two-phase program. The objective of Phase I was to review the literature and identify needs in the areas of resources, harvesting, dewatering, beneficiation, gasification, and environmental studies. The results of Phase I have been previously reported (PB81-222275). The objective of Phase II are to prepare updated peat resource maps and to conduct quantitative economic and environmental assessments of a few selected peat harvesting, dewatering, and beneficiation alternatives. In the task on peat resources, maps of fourteen states have been completed. A number of peat harvesting system designs have been ranked according to their technical merits and a preliminary economic assessment has been made of a wet harvesting method. A preliminary economic comparison of four peat dewatering systems has been made. A description of a beneficiation (wet-carbonization) process and a preliminary economic estimate for producing beneficiated peat is presented. Recent developments in both thermal and biological conversion of peat to SNG are described. The major air and water pollution emission rates from a peat gasification plant producing 250 billion Btu/day of SNG have been estimated. Detailed environmental scenarios have been prepared for three peat bogs typical of those in the Upper Midwest, Northeast, and Southeast United States. Preliminary cost estimates for harvested peatland reclamation options have been made.

Descriptors: *Peat; *Gasification; Harvesting; Cargo transportation; Environmental impacts; Technology; Design criteria; Performance evaluation

Identifiers: Slurry pipelines; NTISGRI

Section Headings: 7A (Chemistry--Chemical Engineering); 21D (Propulsion and Fuels--Fuels); 99B (Chemistry--Industrial Chemistry and Chemical Process Engineering); 97K (Energy--Fuels); 68GE (Environmental Pollution and Control--General)

951223 PB83-135509
Pacific Bulk Commodity Transportation System, Phase III. Volume IV: Marad/Boeing Study
(Final rept)
Boeing Engineering and Construction, Tukwila, WA.
Corp. Source Codes: 076828000
Sponsor: Maritime Administration, Washington, DC. Office of Maritime Technology.
Report No.: MA-RD940-81080
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Country of Publication: United States
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Projections are developed for comparative costs in Japan in 1987 from imported oil and Utah coal transported to Japan by means of the Pacific Bulk Commodity Transportation System. Cost projections are derived from underground mining models and transportation systems for oil and coal utilizing inflation factors derived from economic projections to 1987. Japanese goals for steam coal imports from United States between 1985 and 1990 are described. Overland transportation costs and limited U.S. west coast port capacity are identified as obstacles to U.S.A. reaching this share. Methods of increasing pipeline throughput during startup are described and strategies for replenishment of storage basins at the U.S. terminal and at the overseas coal center are defined. Economics of a Japanese distribution system is analyzed based on the concept of a coal center serving four power plants; two by pipeline and two 150 miles distant served by pusher barge fleet. Comparisons are provided of relative costs of distributing coal in all slurry, solid coal, and a mixed mode systems. Trends in underground coal mine productivity in Utah are analyzed. Possible delays in design and construction of the Pacific Bulk Commodity Transportation System are reviewed.
Descriptors: *International trade; *Coal handling; Water transportation; Pipeline transportation; Slurries; Marketing; Japan; Exports; Distribution systems; Cost comparison
Identifiers: *Slurry pipelines; NTISDOTMA
Section Headings: 5C (Behavioral and Social Sciences--Economics); 8I (Earth Sciences and Oceanography--Mining Engineering); 13B (Mechanical, Industrial, Civil, and Marine Engineering--Civil Engineering); 96A* (Business and Economics--Domestic Commerce, Marketing, and Economics); 48A* (Natural Resources and Earth Sciences--Mineral Industries); 85E* (Transportation--Pipeline Transportation); 85G (Transportation--Marine and Waterway Transportation)

922330 PB82-224668
Characterization, Renovation, and Utilization of Water from Slurry Transport Systems
(Completion rept. 1 Oct 79-30 Sep 81)
Managhan, Stanley E. ; Gale, Robert ; Disinger, James ;
Missouri Water Resources Research Center, Columbia.
Corp. Source Codes: 060367000
Sponsor: Office of Water Research and Technology, Washington, DC.
Report No.: W8205289; OWRTB-145-MO(2)
1 Feb 82 24p
Languages: English
NTIS Prices: PC A02/MF A01
Country of Publication: United States
Journal Announcement: GRAI8221
Contract No.: DI-14-34-0001-0228; OWRT-B-145-MO
An understanding of water-solid interactions under slurry conditions is needed in order to characterize, renovate, and utilize water from slurry transport systems. To address this need, study emphasis was placed on two major considerations: water interchange between the suspending medium and the coal and coal-derived solids; and the interaction of coal and coal-derived solids with chromium (VI), or chromate, an anticorrosive agent that may be used in coal slurries. The methodology employed here and the concept of exchangeable water and its dilution effect should be useful in future studies of coal-water interactions.
Descriptors: *Slurries; *Pipeline transportation; *Fuels; Design criteria; Performance evaluation; Pollution; Water exchange; Sorption; Coal; Corrosion prevention; Forecasting
Identifiers: *Slurry pipelines; NTISDIOWRT
Section Headings: 21D (Propulsion and Fuels--Fuels); 97K (Energy--Fuels); 85E (Transportation--Pipeline Transportation)

902778 PB82-806332
Materials Handling by Slurry Pipelines. August, 1980-February, 1982 (Citations from the Engineering Index Data Base)
National Technical Information Service, Springfield, VA.
Corp. Source Codes: 055665000
Mar 82 119p
Supersedes PB80-814650, and NTIS/PS-79/0848.
Languages: English Document Type: Bibliography
NTIS Prices: PC NO1/MF NO1
Country of Publication: United States
Journal Announcement: GRAI8213
Worldwide research on slurry pipelines containing coal, crude oil, minerals, sand, gravel, metallic ores, industrial wastes, and municipal wastes are cited. Studies on pumps, pipes, fluid flow, hydraulics, and design are included. Characteristics of transported materials are covered. Underwater pipelines and underground pipelines are also covered. (This updated bibliography contains 114 citations, all of which are new entries to the previous edition.) Previous editions of this search, containing older citatiogs, are PB80-814650 and NTIS/PS-79/0848.
Descriptors: *Bibliographies; *Pipeline transportation; *Materials handling; *Coal; *Mineral deposits; Pumps; Pipes; Design; Dredging; Fluid flow; Crude oil; Solid waste disposal; Industrial wastes; Abstracts
Identifiers: *Slurry pipelines; NTISNTISI
Section Headings: 8I (Earth Sciences and Oceanography--Mining Engineering); 13B (Mechanical, Industrial, Civil, and Marine Engineering--Civil Engineering); 48A* (Natural Resources and Earth Sciences--Mineral Industries); 85E* (Transportation--Pipeline Transportation); 97K* (Energy--Fuels); 68GE (Environmental Pollution and Control--General)

902777 PB82-806324
Materials Handling by Slurry Pipelines. 1970-July, 1980 (Citations from the Engineering Index Data Base)
National Technical Information Service, Springfield, VA.
Corp. Source Codes: 055665000
Mar 82 295p
Languages: English Document Type: Bibliography
NTIS Prices: PC NO1/MF NO1
Country of Publication: United States
Journal Announcement: GRAI8213
Worldwide research on slurry pipelines containing coal, crude oil, minerals, sand, gravel, metallic ores, industrial wastes, and municipal wastes are cited. Studies on pumps, pipes, fluid flow, hydraulics, and design are included. Characteristics of transported materials are covered. Underwater pipelines and underground pipelines are also covered. (This updated bibliography contains 290 citations, none of which are new entries to the previous edition.)
Descriptors: *Bibliographies; *Pipeline transportation; *Materials handling; *Coal; *Mineral deposits; Pumps; Pipes; Design; Dredging; Fluid flow; Crude oil; Solid waste disposal; Industrial wastes; Abstracts
Identifiers: *Slurry pipelines; NTISNTISI
Section Headings: 8I (Earth Sciences and Oceanography--Mining Engineering); 13B (Mechanical, Industrial, Civil, and Marine Engineering--Civil Engineering); 48A* (Natural Resources and Earth Sciences--Mineral Industries); 85E* (Transportation--Pipeline Transportation); 97K* (Energy--Fuels); 68GE (Environmental Pollution and Control--General)

893499 DE82003019
Transport Characteristics of Alternate Slurry Fuels. Quarterly Technical Progress Report, July-September 1981
Department of Energy, Pittsburgh, PA. Pittsburgh Energy Technology Center.
Corp. Source Codes: 055636003; 9507753
Sponsor: Department of Energy, Washington, DC.
Report No.: DOE
1981 9p
Available in microfiche only.
Languages: English
NTIS Prices: MF AO1
Country of Publication: United States
Journal Announcement: GRAI8210; NSA0700
The objective of this project is to develop flow data for various alternate fuels, such as coal/water mixtures, in a pump loop which accurately simulates fuel feed systems found in boiler and furnace applications. The program is primarily concerned with measurement and correlation of pressure loss as a function of slurry characteristics and system design. The flow studies are being supported by laboratory studies. Construction of the one-inch loop was completed. Pressure transducers, thermocouples and a mass flow meter were installed and linked to a data acquisition system. A series of preliminary tests has been conducted flowing water, 60%, 63% and 65% coal-water mixtures. The bulk of the CWM's contained an additive, Lomar-D, at a dosage of approximately .5% by total mix weight. These tests were conducted primarily to evaluate the design of the loop, the adequacy of the instrumentation and the reproducibility of the CWM preparation method. The design of the loop appears to be fundamentally sound. (ERA citation 07:003206)
Descriptors: *Fuel slurries; *Hydraulic transport; Additives; Coal; Fuel feeding systems; Measuring instruments; Mixtures; Pressure drop; Test facilities; Water
Identifiers: ERDA/013000; NTISDE
Section Headings: 21D (Propulsion and Fuels--Fuels); 85E (Transportation--Pipeline Transportation); 97K (Energy--Fuels)

845021 FE-2434-62
Pipeline Gas from Coal - Hydrogenation (IGT Hydrogasification Process). Quarterly Report No. 15, January 1-March 31, 1980
Institute of Gas Technology, Chicago, IL.
Corp. Source Codes: 013602000; 9500656
Sponsor: Department of Energy, Washington, DC.
Dec 80 80p
Available in microfiche only.
Languages: English
NTIS Prices: MF A01
Country of Publication: United States
Journal Announcement: GRAI8117; NSA0600
Contract No.: AC01-76ET10163

Pilot plant operations and related support studies necessary to establish a data base to optimize the HYGAS SNG process design are being performed. Work during most of the quarter was concentrated on plant turnaround activities and on modifications for Test 85. Major effort centered on replacing the refractory in the high-temperature reactor (HTR). Coal crushing and pretreater tests were run with washed Western Kentucky coal to determine its crushing and agglomerating characteristics. As a result, the operating temperature and the superficial velocity were increased to obtain a more uniformly pretreated product. Test 85 began with reactor light-off on March 20, followed by self-sustained steady-state operation beginning March 27. At the close of this quarter, 51 hours of steady-state operation had been logged. Test 85 is currently running and is expected to continue through the first part of April. Ten tests were conducted in the 6-inch process development unit (PDU). Data from the most recent series of pneumatic conveying tests were compared with several published correlations for chokking velocity and lift-line pressure drop. Data from the most recent series of pneumatic conveying tests were compared with several published correlations for choking velocity and lift-line pressure drop. Inspection of the low-temperature reactor (LTR) and raw-gas primary filter assemblies confirmed the units' efficient removal of fines from the gas sample stream. An ultrasonic survey of the quench tower vessel was completed. Results indicate that no significant loss in wall thickness has occurred in the quench tower carbon steel shell after 9 years of exposure to HYGAS process product gases. Selected sections of the oil and water slurry piping loops were radiographed, and the existing high-pressure cyclone was examined by both radiographic and ultrasonic methods. (ERA citation 06:015197)

Descriptors: *Hygas process; Chemical analysis; Coal; Coal gasification plants; Diagrams; Equipment; Experimental data; Gas yields; High btu gas; Operation; Optimization; Pilot plants; Production; Research programs
Identifiers: ERDA/010404; ERDA/090121; NTISDE
Section Headings: 7A (Chemistry--Chemical Engineering); 21D (Propulsion and Fuels--Fuels); 99B (Chemistry--Industrial Chemistry and Chemical Process Engineering); 97F (Energy--Fuel Conversion Processes)

841438 DOE/ET/12548-4
Critical Parameters for Coarse Coal Underground Slurry Haulage Systems
Maynard, D. P.
Jet Propulsion Lab., Pasadena, CA.
Corp. Source Codes: 014828000; 3430000
Sponsor: Department of Energy, Washington, DC.
Report No.: JPL-PUB-81-11
15 Feb 81 55p
Languages: English
NTIS Prices: PC A04/MF A01
Country of Publication: United States
Journal Announcement: GRAI8116; NSA0600
Contract No.: AI01-76ET12548

This report describes the basic parameters which directly influence the behavior of a coal slurry pipeline transportation system and determine the limitations of the system performance. The purpose of this technology assessment is to provide an identification and understanding of the critical factors which must be given consideration in the design and evaluation of such a slurry haulage system intended for use in an underground coal mine. The slurry haulage system will be utilized to satisfy the transportation requirements of conveying, in a pipeline, the coal mined by a continuous mining machine to a storage location near the mine entrance or to a coal preparation plant located on the surface. Coal-water slurries, particularly those consisting of homogeneous suspensions of small particles, frequently behave as non-Newtonian, Bingham-plastic fluids. For successful operation, slurry transport systems should be designed to operate in the turbulent flow regime and at a flow rate at least 30% greater than the deposition velocity. The deposition velocity is defined as the slurry flow rate at which the solid particles tend to settle in the pipe. Due to the importance of accurately determining the deposition velocity and the uncertainties of current methods for predicting the deposition velocity of coarse particle slurries, it is recommended that experimental efforts be performed as a part of the system design. The capacity of the haulage system should be compatible with the mine's projected coal output in order to avoid operational delays and the necessity for in-mine coal storage. The slurry pumps must generate sufficient discharge pressure to overcome the resultant friction losses in horizontal and vertical pipe sections and to satisfy the slurry hoisting requirements. (ERA citation 06:013340)

Descriptors: *Hydraulic transport; *Underground mining; Coal mining; Control; Design; Dusts; Experimental data; Fluid mechanics; Friction factor; Mine haulage; Particle size; Pressure drop; Pumps; Reynolds number; Roughness; Slurry pipelines; Technology assessment
Identifiers: ERDA/012000; ERDA/013000; NTISDE
Section Headings: 8I (Earth Sciences and Oceanography--Mining Engineering); 48A (Natural Resources and Earth Sciences--Mineral Industries)

814556 PNL-3468
Separate Effects Test Stand for Obtaining Hydrotransport Data
Allen, C. H.
Battelle Pacific Northwest Labs., Richland, WA.
Corp. Source Codes: 048335000; 9500022
Sponsor: Department of Energy, Washington, DC.
Aug 80 25p
Languages: English
NTIS Prices: PC A02/MF A01
Country of Publication: United States
Journal Announcement: GRAI8105; NSA0500
Contract No.: AC06-76RLO1830

Based on earlier hydrotransport research by English and Russian researchers, a special test stand has been designed and constructed to obtain data to determine hydraulic drag, pipe wear, and comminution of particles. These data are intended for design and separate-effects operating information. This information will be used to supplement data developed by the Hydrotransport Research Facility located at the Pittsburgh Mining Operations, Pittsburgh, Pennsylvania. This report describes the equipment as designed, explains how the hydraulic drag is calculated using test-stand data, and presents some preliminary tests results using water. Tests using water are continuing to further substantiate the system and later, tests will be started using slurries. (ERA citation 05:033233)

Descriptors: *Hydraulic transport; Coal; Comminution; Drag; Mine haulage; Pressure drop; Slurry pipelines; Test facilities ; Wear
Identifiers: ERDA/013000; ERDA/294000; NTISDE
Section Headings: 8I (Earth Sciences and Oceanography--Mining Engineering); 48A (Natural Resources and Earth Sciences--Mineral Industries)

798692 PB80-814650
Materials Handling By Slurry Pipelines. 1970-July, 1980 (Citations from the Engineering Index Data Base)
(Rept. for 1970-Jul 80)
Hundemann, Audrey S.
National Technical Information Service, Springfield, VA.
Corp. Source Codes: 055665000
Sep 80 246p
Supersedes NTIS/PS-79/0848, and NTIS/PS-78/0721.
Languages: English Document Type: Bibliography
NTIS Prices: PC N01/MF N01
Country of Publication: United States
Journal Announcement: GRAI8025
Worldwide research on slurry pipelines containing coal, crude oil, minerals, sand, gravel, metallic ores, industrial wastes, and municipal wastes are cited. Studies on pumps, pipes, fluid flow, hydraulics, and design are included. Characteristics of transported materials are covered. Underwater pipelines and underground pipelines are also covered. (This updated bibliography contains 290 citations, 49 of which are new entries to the previous edition.)
Descriptors: *Bibliographies; *Pipeline transportation; *Materials handling; *Coal; *Mineral deposits; Pumps; Pipes; Design; Dredging; Fluid flow; Crude oil; Solid waste disposal; Industrial wastes; Abstracts
Identifiers: *Slurry pipelines; NTISNTISI
Section Headings: 8I (Earth Sciences and Oceanography--Mining Engineering); 13B (Mechanical, Industrial, Civil, and Marine Engineering--Civil Engineering); 48A* (Natural Resources and Earth Sciences--Mineral Industries); 85E* (Transportation--Pipeline Transportation); 97K* (Energy--Fuels); 68GE (Environmental Pollution and Control--General)

797108 FE-9033-T2
Evaluation of Alternate Hydraulic Transport Concepts for Coal Haulage in Underground Mines. Final Technical Report
Szekely, S. M. ; Kurz, M. G. ; Yegulalp, T. M.
Transflux International Ltd., Fort Lee, NJ.
Corp. Source Codes: 9506185
Sponsor: Department of Energy, Washington, DC.
Nov 79 380p
Languages: English
NTIS Prices: PC A17/MF A01
Country of Publication: United States
Journal Announcement: GRAI8025; NSA0500
Contract No.: ET-76-C-01-9033
A cost data bank and two computer programs developed as part of this study allow the user to select an economical pipe configuration for a multi-panel underground coal slurry transport system. The feasibility and controllability of such a system had been proven in previous studies. The programs allow the user to update the data bank and vary otherwise the inputs to meet a wide variety of conditions. Using the programs and a set of predetermined conditions, a number of pump and surge volume configurations for 2, 4 and 8 section mines. It was assumed that one continuous miner operates in each section, with possibly simultaneous full output. One set of runs was based on a set miner cycle time while another on cycles developed by stochastic probability analysis. The first runs were using a system operated with fixed flow rates while the other with variable flows. The second set of conditions offered only insignificant cost advantages for a given configuration. The results indicate considerable cost advantages toward larger and more complex systems using a minimum number of pipe and pumps, since first cost is the overwhelmingly significant cost factor. The effect of size attrition on a coal preparation plant and on plant operations has also been addressed. It was found to increase both complexity and expenses but without significant increase in total mine mouth coal cost. (ERA citation 05:025258)
Descriptors: *Hydraulic transport; *Slurry pipelines; *Underground mining; Coal mining; Computer calculations; Design; Engineering; Mine haulage; Numerical data
Identifiers: ERDA/013000; ERDA/012000; NTISDE
Section Headings: 8I (Earth Sciences and Oceanography--Mining Engineering); 9B (Electronics and Electrical Engineering--Computers); 48A (Natural Resources and Earth Sciences--Mineral Industries); 85E (Transportation--Pipeline Transportation)

789075 PATENT-4 174 728
Sliding-Gate Valve
(Patent).
Usnick, G. B. ; Ward, G. T. ; Blair, H. O. ; Roberts, J. W. ; Warner, T. N.
Department of Energy, Washington, DC.
Corp. Source Codes: 052661000
Report No.: PAT-APPL-851 330
Filed 14 Nov 77 patented 20 Nov 79 8p
Supersedes PAT-APPL-851 330-77.
This Government-owned invention available for U.S. licensing and, possibly, for foreign licensing. Copy of patent available Commissioner of Patents, Washington, DC 20231 $0.50.
Languages: English Document Type: Patent
NTIS Prices: Not available NTIS
Country of Publication: United States
Journal Announcement: GRAI8022; NSA0500
This invention is a novel valve of the slidable-gate type. The valve is designed especially for long-term use with highly abrasive slurries. The sealing surfaces of the gate are shielded by the valve seats when the valve is fully open or closed, and the gate-to-seat clearance is swept with an inflowing purge gas while the gate is in transit. A preferred form of the valve includes an annular valve body containing an annular seat assembly defining a flow channel. The seat assembly comprises a first seat ring which is slidably and sealably mounted in the body, and a second seat ring which is tightly fitted in the body. These rings cooperatively define an annular gap which, together with passages in the valve body, forms a guideway extending normal to the channel. A platetype gate is mounted for reciprocation in the guideway between positions where a portion of the plate closes the channel and where a circular aperture in the gate is in register with the channel. The valve casing includes opposed chambers which extend outwardly from the body along the axis of the guideway to accommodate the end portions of the gate. The chambers are sealed from atmosphere; when the gate is in transit, purge gas is admitted to the chambers and flows inwardly through the gate-to-seat-ring clearance, minimizing buildup of process solids therein. A shaft reciprocated by an external actuator extends into one of the sealed chambers through a shaft seal and is coupled to an end of the gate. Means are provided for adjusting the clearance between the first seat ring and the gate while the valve is in service. 6 claims. (ERA citation 05:029460)
Descriptors: *Slurry pipelines; *Valves; Abrasion; Design
Identifiers: ERDA/420205; *Patents; NTISGPDE; NTISDE
Section Headings: 13K (Mechanical, Industrial, Civil, and Marine Engineering--Pumps, Filters, Pipes, Fittings, Tubing, and Valves); 90A (Government Inventions For Licensing--Mechanical Devices and Equipment); 85E (Transportation--Pipeline Transportation)

788802 NP-24424
Economic Aspects of the Solids-Water Transportation of Coal
Koehling, R. ; Leininger, D.
1976 14p
A, Aufbereit.-Tech. n11 P574-579 1976.
U.S. Sales Only.
Languages: English Document Type: Translation
NTIS Prices: PC A02/MF A01
Country of Publication: Germany, Federal Republic of
Journal Announcement: GRAI8022; NSA0500
The following conclusions can be derived from the considerations outlined above: efforts must be made to reduce as far as possible the cost of the starting and terminating stations. One way of doing this would be to set a higher upper limit on the grain size of the transported slurry and thereby design the installations for primary and secondary treatment more cheaply. The cost of dewatering must be brought down by applying the findings of the research project, Optimization of Dewatering, carried out by the Steinkohlenbergbauverein, Essen and subsidized by the Land of North-Rhine Westfalia. Efforts must continually be made to re-utilize the transport water, e.g., for cooling or quenching purposes. When looking at the profitability of hydraulic coal transport, all the factors affecting cost and revenue must be taken into account. As the upper size limit is raised, knowledge of the interrelationships involved in producing a stable suspension must be extended and used for reducing costs. The multiplicity of factors and their interaction does not allow of any definitive, university valid conclusion on the profitability of hydraulic solids transport. For each possible application, the technical-economic optimum must be established with the aid of a mathematical model. The particular advantages which hydraulic pipeline transport offers for many applications guarantee a secure place for this transport technique. (ERA citation 05:020018)
Descriptors: *Hydraulic transport; Backfilling; Barges; Coal ; Coal preparation plants; Comparative evaluations; Conveyors; Economics; Mine haulage; Mineral wastes; Railways; Slurry pipelines; Solids; Transport; Trucks; Water removal
Identifiers: *Foreign technology; ERDA/013000; Translations; NTISDET
Section Headings: 81 (Earth Sciences and Oceanography--Mining Engineering); 48A (Natural Resources and Earth Sciences--Mineral Industries); 85E (Transportation--Pipeline Transportation)

785810 FE-3274-1
Experimental Design for Hydraulic Transport Research Facility. Final Technical Report
Faddick, R. R.
Colorado School of Mines, Golden.
Corp. Source Codes: 006683000; 1819000
Sponsor: Department of Energy, Washington, DC.
Dec 79 169p
Languages: English
NTIS Prices: PC A08/MF A01
Country of Publication: United States
Journal Announcement: GRAI8021; NSA0500
Contract No.: ET-78-S-01-3274

A research program was to be defined for the operation of the newly constructed Hydraulic Transport Research Facility (HTRF). The program was to be designed to obtain engineering data for the design of efficient, economical, and reliable raw coal hydraulic haulage systems from the mine face to the wash plant. The research program was to be completed in the shortest feasible time and at the lowest operating cost. A five-year experimental design consisting of three phases was developed. After a two-month calibration period, Phase I (first year) tests all three pipeline diameters with both a washed and unwashed coal at varying slurry concentrations. Headlosses, deposition velocities, and exploratory work on flow transients constitute the test program. Phase II (second year) allows for implementation of the data logger for examination of particle size distribution and flow transients. Phase III (next three years) comprises a definitive study on transients, particle size, and studies different coals and coal-refuse mixtures. New technology is also to be examined. It is recommended that a separate analytical team be formed from the current contractor team to coordinate the data generated by the HTRF and develop it for industry's use. (ERA citation 05:021699)

Descriptors: *Hydraulic transport; *Underground mining; Coal ; Coal mining; Design; Experiment planning; Mine haulage; Specifications; Test facilities
Identifiers: ERDA/012000; ERDA/013000; NTISDE
Section Headings: 8I (Earth Sciences and Oceanography--Mining Engineering); 48A (Natural Resources and Earth Sciences--Mineral Industries)

780766 FE-3055-T9
SRC-II Demonstration Project. Phase Zero, Task Number 1: Deliverable Number 1. Demonstration Plant Description
Pittsburg and Midway Coal Mining Co., Denver, CO.
Corp. Source Codes: 9508185
Sponsor: Department of Energy.
31 Jul 79 1040p
Languages: English
NTIS Prices: PC A99/MF A01
Country of Publication: United States
Journal Announcement: GRAI8019; NSA0500
Contract No.: ET-78-C-01-3055

per stream day (tpsd) demonstration-size SRC-II coal liquefaction plant. The plant has been designed as a fully integrated, grass roots facility with the capability of expansion to commercial size. This design approach is consistent with the objectives detailed for Phase Zero in Task 1 of Appendix A of Contract No. DE-AC05-78OR03055 (Formerly Contract No. ET-78-C-01-3055) between The Pittsburg and Midway Coal Mining Co. (P and M) and the United States Department of Energy (DOE). Primary engineering and design for the plant was prepared by Stearns-Roger Incorporated under the direction of The Pittsburg and Midway Coal Mining Co. The primary product is a low sulfur distillate fuel oil, suitable for power plant use in areas with stringent sulfur regulations. The physical and chemical characteristics of this coal-derived oil are such that little or no modification is required to burn the product in existing utility boilers. Although the process has been designed to maximize the production of fuel oil, other valuable products are also produced. These additional major process products include: pipeline quality gas, liquefied propane gases, mixed butanes, naphtha, anhydrous ammonia, and sulfur. Special design studies have also been made to assess critical processes and equipment associated with a demonstration or commercial size coal liquefaction plant. These studies include completed reports concerning: reactor kinetics, reactor process dynamics of three-phase flows, gasification designs and systems, hydrogen purification processes and sulfur recovery, oxygen compression, dissolver slurry preheater, and critical equipment, instrumentation, and materials of construction. (ERA citation 05:011098)

Descriptors: *Demonstration plants; *Src-ii process; Coal liquefaction; Coal liquefaction plants; Design; Engineering; Hydrogen production; Pilot plants
Identifiers: ERDA/010405; NTISDE
Section Headings: 7A (Chemistry--Chemical Engineering); 21D (Propulsion and Fuels--Fuels); 99B (Chemistry--Industrial Chemistry and Chemical Process Engineering); 97F (Energy--Fuel Conversion Processes)

776340 COO-4935-2
Transportation of Coal by Hydraulic Container Pipeline (HCP): A Feasibility Study
Liu, H. ; Assadollahbaik, M. ; Yang, J. C.
Missouri Univ.-Columbia. Dept. of Civil Engineering.
Corp. Source Codes: 9509214
Sponsor: Department of Energy.
May 79 71p
Languages: English
NTIS Prices: PC A04/MF A01
Country of Publication: United States
Journal Announcement: GRAI8018; NSA0500
Contract No.: EM-78-S-02-4935

The purpose of this sponsored research is to assess the feasibility and the potential value of HCP (Hydraulic Container Pipeline) as a new mode of freight transport. The tasks of the study involve (1) assessment of the energy conservation value of HCP as compared to other modes of freight transport such as truck, rail and slurry pipeline, (2) assessment of the market of HCP for coal transportation, (3) development of design concepts on HCP system for transporting coal, and (4) design and construction of a small HCP system for the demonstration of the concept of HCP transportation. To date, the first three of the four aforementioned tasks have been completed; task 4 has just begun. This report deals with tasks 2 and 3. Another report, entitled Energy Conservation Value of Hydraulic Container Pipeline (HCP), deals with task 1. It is shown in this report that a large market exists for HCP to transport coal. Not only is HCP the most environmentally and socially acceptable way to transport coal, it can also compete effectively with truck, train and even slurry pipeline on economic grounds. (ERA citation 05:008051)

Descriptors: *Coal; *Hydraulic transport; Comparative evaluations; Economics; Feasibility studies; Pipelines; Railways; Trucks
Identifiers: ERDA/013000; NTISDE
Section Headings: 81 (Earth Sciences and Oceanography--Mining Engineering); 48A (Natural Resources and Earth Sciences--Mineral Industries)

776339 COO-4935-1
Energy Conservation Value of Hydraulic Container Pipeline (HCP). Project Completion Report, June 1, 1978-April 30, 1979
Liu, H. ; Assadollahbaik, M.
Missouri Univ.-Columbia. Dept. of Civil Engineering.
Corp. Source Codes: 9509214
Sponsor: Department of Energy.
Feb 79 42p
Languages: English
NTIS Prices: PC A03/MF A01
Country of Publication: United States
Journal Announcement: GRAI8018; NSA0500
Contract No.: EM-78-S-02-4935

The purpose of this sponsored research is to assess the feasibility and the potential value of the hydraulic container pipeline (HCP) as a new mode of freight transport. The tasks of the study involve (1) assessment of the energy conservation value of HCP as compared to other modes of freight transport such as truck, rail and slurry pipeline, (2) assessment of the market of HCP for coal transportation, (3) development of design concepts on HCP system for transporting coal, and (4) design and construction of a small HCP system for the demonstration of the concept of HCP transportation. To date, the first three of the four aforementioned tasks have been completed; task 4 has just begun. This report deals with the first task only. It is shown that HCP possesses high potential for conserving energy used in freight transport and reducing U.S. reliance on oil. (ERA citation 05:007318)

Descriptors: *Coal; *Hydraulic transport; *Transportation systems; Containers; Energy conservation; Energy efficiency; Feasibility studies; Numerical data; Pipelines; Research programs; Slurries; Tables; Technology assessment
Identifiers: ERDA/320205; ERDA/013000; *Pipeline transportation; *Energy transport; Cargo transporttion; NTISDE
Section Headings: 21D (Propulsion and Fuels--Fuels); 97K (Energy--Fuels); 85E (Transportation--Pipeline Transportation)

773054 CONF-791160-2
Coal/Oil Mixture Pipeline: A Viable Alternative Coal Transportation System
Harkness, J. B. L. ; Petrovic, L. J.
Argonne National Lab., IL.
Corp. Source Codes: 001960000; 0448000
Sponsor: Resource Engineering, Inc., Burlington, MA.; Department of Energy, Washington, DC.
1979 23p
International symposium on coal-oil mixture combustion, Danvers, MA, USA, 27 Nov 1979.
Languages: English Document Type: Conference proceeding
NTIS Prices: PC A02/MF A01
Country of Publication: United States
Journal Announcement: GRAI8017; NSA0500
Contract No.: W-31-109-ENG-38

Slurry pipeline systems have been promoted as minimizing the environmental and socio-economic impacts of rail transportation and as increasing competition in interstate coal transportation. However, the scarce water resources of the coal rich western states may limit the number and/or capacity of these systems. Furthermore, these systems are not without their own operating and environmental problems. In this paper, a coal transportation system which utilizes coal/oil mixture technology is compared to the coal/water system and to another alternative, coal/methanol system. The primary considerations addressed are the system design considerations and trade-offs, the resource requirements (including capital) and the cost of delivered energy. Considerations such as the system environmental impacts, the status of the technologies, oil quality and supply, and the potential system flexibilities are discussed qualitatively. This qualitative comparison shows that the coal/oil slurry pipeline is an attractive economic, environmental, and technical alternative for transporting coal PROVIDED that oil is available in the region. Coal/water pipelines are a second choice based on economics and, furthermore, are limited by their demands on western water resources. The third choice is coal/oil slurry pipelines using oil generated onsite. The main attraction is the saving of about 1/2 the water requirements. However, the capital costs will be high. Coal/methanol slurry pipelines do not appear to have any economic or environmental advantages. Further secondary considerations must be addressed before a technically and economically viable coal/oil surry pipeline could be implemented. (ERA citation 05:014740)

Descriptors: *Coal; *Fuel slurries; *Slurry pipelines; Coal liquefaction; Economic analysis; Environmental impacts; Fuel oils; Methanol; Mixtures; Socio-economic factors; Transport; Viscosity; Water; Water requirements
Identifiers: ERDA/013000; ERDA/014000; ERDA/025000; NTISDE
Section Headings: 8I (Earth Sciences and Oceanography--Mining Engineering); 48A (Natural Resources and Earth Sciences--Mineral Industries); 85E (Transportation--Pipeline Transportation)

Coarse Coal Hydrotransport Data Predictions
Lombardo, N. J. ; Eyler, L. L.
Battelle Pacific Northwest Labs., Richland, WA.
Corp. Source Codes: 048335000; 9500022
Sponsor: Department of Energy, Washington, DC.
Jan 80 48p
Languages: English
NTIS Prices: PC A03/MF A01
Country of Publication: United States
Journal Announcement: GRAI8016; NSA0500
Contract No.: EY-76-C-06-1830

This report describes an independent evaluation of the hydrodynamic data obtained with coarse coal in 3- and 6-in. recirculation loops. The measured data are compared with several recently published predictive methods to evaluate data quality and determine data trends. A limited parameterization of these models to investigate their sensitivity is also presented. In recirculating loop tests, velocity ranges of 2 through 15 ft/sec were used to pump solid concentrations of up to 45% by weight. Pressure drop data were obtained for particle-to-pipe diameter ranges to 0.25 under various flow conditions. The predictive methods used to analyze the hydrodynamic data obtained include mechanistic models and empirical correlations. For each method, predicted versus measured headloss gradients were plotted to evaluate the ability of each method to reproduce the parameter trends exhibited by the pressure drop data. Of the five methods selected for analyzing the data, three could be used to predict the head loss gradients with some certainty, including a sliding bed model that provided predicted results equal to a regression analysis of the original data. The original correlation of the data was found to be capable of reproducing 90% of the measured results to within +-30%. It was therefore concluded that the original correlation and the sliding bed model provided sufficient accuracy to be used as a means for estimating the headloss for coarse particle coal systems in 3- and 6-in. lines. The success of the predictive methods in reproducing the parameter trends indicate that the data obtained were reasonably accurate and reliable. It is is expected that mechanistic models can become a valuable design tool for predicting hydrotransport performance over ranges of parameters. (ERA citation 05:013026)

Descriptors: *Coal; *Slurry pipelines; Comparative evaluations; Correlations; Friction factor; Mathematical models; Parametric analysis; Pressure drop; Transport
Identifiers: ERDA/013000; NTISDE
Section Headings: 8I (Earth Sciences and Oceanography--Mining Engineering); 48A (Natural Resources and Earth Sciences--Mineral Industries)

Print 19/5/1-7
DIALOG File6: NTIS - 64-83/Iss8 (Copr. NTIS) (Item 1 of 7) User 1446 9mar83 2319

921080 DE82901380
Hydraulic Transportation of Imported Coal. A Schematic System Assessment
Seligren, A.
Studsvik Energiteknik A.B., Nykoeping (Sweden).
Corp. Source Codes: 056472000; 6009900
Report No.: NE
Feb 80 17p
U.S. Sales Only.
Languages: English
NTIS Prices: PC A02/MF A01
Country of Publication: Sweden
Journal Announcement: GRAI8221; NSA0000

Sweden has no domestic resources of coal and an import of up to about 10 Mtonnes per year for energy production has been discussed. A large scale use of steam coal in Sweden will probably be limited by strict environmental regulations. Only coals of very high quality can be considered. If high quality coals are not available at a reasonable price, it may be economically feasible to clean the coal prior to combustion, in combination with stack gas scrubbing to attain given emission standards. In advanced physical cleaning methods the coal is crushed to a maximum particle size of about 1 mm by wet milling. This means that the coal is in the form of a slurry which can easily be transported in pipes. The possibility of Swedish participation in mining operations in an exporting country cannot be excluded. A system based on complete transportation and handling of the coal in the form of a slurry, from a mine abroad and then overseas on a ship to a power plant in Sweden, is not expected to be industrially available within the decade to come. However, in a schematic example, mainly based on technology available at present, a coal imported in a dry state is unloaded, stored and transported as a slurry and the delivered to a power plant. It is suggested that the coal should be cleaned and the refuse should be handled on a nearly dry basis, in order to minimize environmental impacts. The.

Descriptors: *Coal; *Sweden; *Fuel slurries; Transport; Hydraulic transport; Environment; Coal preparation; Economics; Coal industry; Slurry pipelines
Identifiers: *Foreign technology; ERDA/013000; NTISDEE
Section Headings: 8I (Earth Sciences and Oceanography--Mining Engineering); 85E (Transportation--Pipeline Transportation); 48A (Natural Resources and Earth Sciences--Mineral Industries)

814545 PNL-SA-7322
Environmental Concerns Influencing the Future Development of Energy Material Transportation Systems: The Year 2000 Study
DeSteese, J. G.
Battelle Pacific Northwest Labs., Richland, WA.
Corp. Source Codes: 048335000; 9500022
Sponsor: Department of Energy, Washington, DC.
Report No.: CONF-7811174-1
1978 11p

US DOE environmental control symposium, Argonne, IL, USA, 28 Nov 1978.
Languages: English Document Type: Conference proceeding
NTIS Prices: PC A02/MF A01
Country of Publication: United States
Journal Announcement: GRAI8105; NSA0500
Contract No.: AC06-76RL01830

This paper presents results of studies conducted to assess the potentially longer-range problems which could hinder the future development of safe and environmentally-acceptable energy material transportation systems. The purpose of this effort is to recommend appropriate action that contributes to the anticipatory management of possible future problems before they can have serious effects on the adequacy or acceptability of the system. Most significant future concerns in energy material transportation relate to potential institutional, legal, political and social problems. Environmental issues are involved in many of these concerns. Selected environmental concerns are discussed that may influence the future development of transportation systems for fossil and nuclear energy materials during the balance of this century. A distinction between potentially real and perceived concerns is made to emphasize basic differences in the recommended approach to solutions of the respective type of potential problem. (ERA citation 05:035042)

Descriptors: *Fuels; *Transport; Accidents; Environmental impacts; Industrial wastes; Leaks; Natural gas; Nuclear fuels; Oil spills; Public opinion; Railways; Risk assessment; Safety standards; Sludges; Slurry pipelines; Synthetic fuels
Identifiers: ERDA/290700; NTISDE
Section Headings: 10A (Energy Conversion (Non-propulsive)---Conversion Techniques); 97GE (Energy--General)

DIALOG File6: NTIS - 64-83/Iss8 (Copr. NTIS) (Item 3 of 7) User 1446 9mar83

730276 DOE/TIC-10118
Summary of Major Energy Legislation of the 95TH Congress
Department of Energy, Washington, DC. Div. of Legislative Research and Analysis.
Corp. Source Codes: 9509343
Dec 78 158p
Languages: English
NTIS Prices: PC A08/MF A01
Journal Announcement: GRAI7924; NSA0400
The title, sponsor, synopsis, and legislative status of major energy lesiglation of the 95th Congress includes the following subjects: Alaska lands, Alaska gas transportation, antiboycott legislation, backhauling, Canadian fuel imports, cargo preference/tanker safety, Clean Air Act, coal conversion, coal leasing, coal slurry pipelines, cogeneration, dealer protection, Department of Energy (organization), DOE FY 79 appropriations and authorizations, divestiture, electric energy and utilities, energy conservation, energy impact assistance, Energy Policy Institute, ERDA FY 78 authorizations, ERDA/FEA FY 78 appropriations, enhanced oil recovery, environment and safety, FEA FY 78 authorization, fuels transportation safety, gasohol, geothermal energy, insulation standards, liquefied natural gas, mine safety, National Energy Act, natural gas, nuclear energy, nuclear siting and licensing, nuclear waste management, oil and gas leasing, oil import fees, oil pollution liability, oil shale commercialization, outer continental shelf, pipeline destruction, Safe Drinking Water Act, solar energy, state energy management program, strip mining, and uranium mill tailings. (ERA citation 04:043227)
Descriptors: Energy; USA; Clean Air Act; *Legislation; National Energy Act; Reviews
Identifiers: ERDA/293000; *Energy policy; Government policies; National government; NTISDE
Section Headings: 10A (Energy Conversion (Non-propulsive)--- Conversion Techniques); 97G (Energy--Policies, Regulations, and Studies)

694577 PB-291 330
A Biologist's Manual for the Evaluation of Impacts of Coal-Fired Power Plants on Fish, Wildlife, and their Habitats
Lewis, B. G. ; Chee, P. C. ; Goldstein, R. M. ; Kornegay, F. C. ; Mabes, D. L.
Argonne National Lab., IL.
Corp. Source Codes: 033550
Sponsor: Fish and Wildlife Service, Washington, DC. Office of Biological Services.
Report No.: FWS/OBS78/75
Aug 78 226p
See also report dated Mar 78, PB-283 658.
Languages: English
NTIS Prices: PC A11/MF A01
Journal Announcement: GRAI7909
This manual contains generalized summary of the major impacts to biota that are unique to coal-fired power plants. [illegible] include: gaseous and particulate stack emissions, coal slurry pipelines, coal cleaning and storage, limestone preparation and storage liquid effluents, solid wastes, and coal conversion. This manual, in conjunction with the detailed technical report, Impacts of Coal-Fired Power Plants on Fish, Wildlife, and Their Habitats (FWS/OBS-78/29), provides the information biologists need to have effective input to the power plant environmental review process.
Descriptors: *Electric power plants; *Wildlife; *Fishes; *Animal ecology; *Environmental impacts; *Pollution; Coal; Manuals; Fly ash; Particles; Construction; Pipelines; Cooling water; Water pollution; Aquatic biology; Air pollution; Storage; Limestone; Radioactive wastes; Standards; Flue gases; Ground water; Desulfurization; Combustion products
Identifiers: Coal cleaning; Land pollution; *Habitats; NTISDIFWBS; NTISDE
Section Headings: 13B (Mechanical, Industrial, Civil, and Marine Engineering--Civil Engineering); 6F (Biological and Medical Sciences--Environmental Biology); 68GE* (Environmental Pollution and Control--General); 57H* (Medicine and Biology--Ecology); 97R (Energy--Environmental Studies)

679970 PB-286 518

Energy/Environment Fact Book

Laska, Richard

Environmental Protection Agency, Washington, DC. Office of Energy, Minerals and Industry.

Sponsor: Department of Energy, Washington, DC. Assistant Secretary for Policy and Evaluation.

Report No.: EPA-600-9-77

Dec 77 80p

Prepared in cooperation with Department of Energy, Washington, DC. Assistant Secretary for Policy and Evaluation.

Languages: English

NTIS Prices: PC A05/MF A01

Journal Announcement: GRAI7901

The report is divided into three major sections: (1) Standards and Status - Presents those air and water quality and performance standards which apply to energy-related pollutants and sources. Also indicates the status of efforts to control these pollutants. (2) Energy Sources - Associates environmental impacts with various energy - related processes and technologies. Compares alternative fuels, as well as alternative coal technologies, in terms of emissions. (3) Regional Issues - Presents data on such issues as acid rainfall, water availability, coal slurry pipelines and oil spills.

Descriptors: *Energy source development; *Environmental impacts; Electric power generation; Air pollution; Water pollution; Water consumption; Coal mining; Petroleum; Uranium; Coal preparation; Coal gasification; Fossil fuels; Public health; Radiation hazards; Hydrogen sulfide; Carbon dioxide; Sulfur oxides; Oil pollution; Slurry pipelines; Graphs(Charts); Statistical data; Tables(Data)

Identifiers: Western coal; NTISEPAORD; NTISDE

Section Headings: 13B (Mechanical, Industrial, Civil, and Marine Engineering--Civil Engineering); 10A (Energy Conversion (Non-propulsive)--Conversion Techniques); 97R (Energy--Environmental Studies); 68GE (Environmental Pollution and Control--General)

675762 EPRI-AF-791

Coal Preparation for Combustion and Conversion. Final Report

Phillips, P. J.

Gibbs and Hill, Inc., New York.

Corp. Source Codes: 2810000

May 78 295p

NTIS Prices: PC A13/MF A01

Journal Announcement: GRAI7825; NSA0300

This report stresses topics of particular interest to the electric utility industry. It covers the full scope of coal processing, from mine face to post-combustion stack gas clean-up, and provides essential information for assessing the potential contribution of physical (as opposed to chemical) coal beneficiation to a utility's fuel procurement and utilization strategy. A methodology is presented for quantifying direct costs corresponding to six different levels of preparation, ranging from mere rubbish removal from ROM coals to intensive beneficiation of crushed and sized coals in prepared media. Fixed and variable costs, including those representing Btu's lost with washing plant rejects, are tabulated for six preparation levels. Major factors influencing preparation costs are examined and the point made that such costs cannot be forecast without a detailed study of each potential application. This applies equally to estimates of quality improvements achievable and economically justifiable with a particular coal. The blending of low and medium sulfur coals is shown to be an alternative for meeting SO2 standards in some cases, but the reader is cautioned that coals after blending may exhibit disproportionately lower ash fusion temperatures. The effects on power plant operation from burning beneficiated coals are discussed, particularly as they bear on a coal's grindability, its combustion characteristics such as fouling and slagging, and on flue gas treatment systems. Coal transportation costs are investigated on a nationwide basis and impacts of financial and environmental constraints on the coal preparation industry discussed. The report leads to the conclusion that the moderate costs of coal beneficiation are often more than offset by the benefits and savings generated by this practical and proven technology. (ERA citation 03:046489)

Descriptors: *Ashes; *Boilers; *Coal; *Coal preparation plants; *Fossil-fuel power plants; *Pyrite; *Slags; Air pollution abatement; Barges; Chemical composition; Clean air act; Coal gasification; Coal liquefaction; Coal preparation; Cyclone separators; Design; Desulfurization; Economics; Electrostatic precipitators; Elements; Emission; Environmental effects; Equipment; Flotation; Fouling; Jigs; Materials handling; Melting; Mineral wastes; Mixing; Noise pollution; Physical properties; Pollution regulations; Railways; Removal; Reviews; Screens; Slurry pipelines; Storage; Tables; Temperature dependence; Trace amounts; Transport; Viscosity; Washing; Waste disposal; Water pollution control

Identifiers: ERDA/013000; ERDA/010402; Air pollution control; Electric power plants; *Environmental surveys; NTISDEP

Section Headings: 13B (Mechanical, Industrial, Civil, and Marine Engineering--Civil Engineering); 68GE (Environmental Pollution and Control--General); 97R (Energy--Environmental Studies)

591823 PB-268 360
Coal Policy or the Lack Thereof
(Final rept.)
McCullough, Douglas L.
George Washington Univ., Washington, D.C. Energy Policy Research Project.
Sponsor: National Science Foundation, Washington, D.C. Div. of Policy Research and Analysis.
Report No.: NSF/PRA7501111/13/6
Mar 76 46p
NTIS Prices: PC A03/MF A01
Journal Announcement: GRAI7719
Contract No.: NSF-OEP75-01111
This report examines certain key policies that have affected the coal industry including proposed strip-mining legislation, air quality standards, restrictions on coal slurry pipelines, and coal land leasing rules.
Descriptors: *Energy policy; *Government policies; Surface mining; Strip mining; Leasing; Slurry pipelines; Air pollution abatement; Environmental impacts; History; Reviewing; National government
Identifiers: *Coal industry; NTISNSFPRA
Section Headings: 10A (Energy Conversion (Non-propulsive)---Conversion Techniques); 8I (Earth Sciences and Oceanography--Mining Engineering); 97G (Energy--Policies, Regulations, and Studies)

Print 18/5/1-50
DIALOG File8: COMPENDEX - 70-83/Jan (Copr. Engineering Information Inc.) (Item 1 of 50) User 1446 9mar83

1345235 ID NO.- EI8301005235
INTERPIPE '82, INTERNATIONAL PIPELINE TECHNOLOGY EXHIBITION & CONFERENCE, 10TH, 1982.
Anon
INTERPIPE Int Pipeline Technol Exhib Conf 10th, Houston, Tex, USA, Feb 23-25 1982. Publ by Interpipe '82 Conf, Houston, Tex, USA, 1982 422 p CODEN: IPTCDR
Proceedings include 34 papers that deal with the developments in pipeline transportation and impact of government regulations on pipelines; pipeline design for pollution control; unconventional pipelines; new pipeline developments in cold regions; pipeline materials and control systems; pipeline construction and operations; and pipeline emergencies. Technical and professional papers from this conference are indexed with the conference code no. 00882 in the Ei Engineering Meetings (TM) database produced by Engineering Information, Inc.
DESCRIPTORS: *PIPELINES, PETROLEUM PIPELINES, NATURAL GAS PIPELINES, SLURRY PIPELINES, WATER PIPELINES, ENVIRONMENTAL PROTECTION,
CARD ALERT: 619, 901, 511, 512, 522, 446

1327809 ID NO.- EI8212107809
REMOVAL OF SUSPENSIONS FROM ASH SLURRY IN EFFLUENT OF STEAM GENERATION PLANT.
Deshpande, V. P.; Gadkari, S. K.; Raman, V.; Patki, S. A.
Natl Environ Eng Res Inst, Nagpur, India
Indian J Environ Health v 24 n 1 Jan 1982 p 14-30 CODEN: IJEHBP
ISSN 0367-827X
Fly ash from a steam generation plant is transported to the lagoons by hydraulic slurrying at a fertilizer unit. This has resulted in escape of excess suspended solids from the lagoons to the water course. A system has been worked out to rationally design the units. Based on the properties of flyash and the results of Jar tests and column settling tests, a suitable treatment flowsheet for removal of flyash and floatables has been arrived at. Reuse of supernatent for slurrying has also been suggested. 5 refs.
DESCRIPTORS: (*FLY ASH, *Flocculation), (SLURRY PIPELINES, Applications), (SEWERS, Storm Drainage), (SEWAGE TANKS, Settling Tanks),
CARD ALERT: 521, 802, 619, 452

1322270 ID NO.- EI8211102270
CHARACTERISTICS OF SLURRY FUELS.
Anon
IHI Eng Rev (Engl Ed) v 15 n 2 Apr 1982 p 51-58 CODEN: IHERA6
ISSN 0018-9820
The coal-oil mixture (COM) is used lately as a substitute for oil. This article presents the results of the tests concerning the properties and the stabilities of the various slurry fuels including COM. 4 refs.
DESCRIPTORS: (*SLURRY PIPELINES, *Design),
CARD ALERT: 619

1303126 ID NO.- EI8209083126
NEW TECHNOLOGY FOR THE DESIGN OF SLURRY PUMPS.
Fatzinger, Jon
A-S-H Pump/A-S-H Molded
World Min v 35 n 3 Mar 1982 p 59-61 CODEN: WOMIDL
ISSN 0043-8707
A monitored installation involves a pump handling autogenous mill discharge at an iron ore property in Quebec, Canada. The operating data suggest that a thick rubber design is a step in the direction of achieving a pump that exhibits high initial efficiency and a long wear life.
DESCRIPTORS: (*SLURRY PIPELINES, *Pumps),
CARD ALERT: 619, 618

1303125 ID NO.- EI8209083125
PUMPING FOR LESS MONEY AT HIGHER EFFICIENCY.
Lidin, Jan
Sala Int, Swed
World Min v 35 n 3 Mar 1982 p 52-53 CODEN: WOMIDL
ISSN 0043-8707
Economy can be achieved by extending wear part life, improving stuffing box design, and simplifying maintenance.
DESCRIPTORS: (*SLURRY PIPELINES, *Pumps),
CARD ALERT: 619, 618, 911

1288253 ID NO.- EI8208068253
PRESSURE DROP FOR SLURRY TRANSPORT.
Lin, S. H.
GE, Pittsfield, Mass, USA
Chem Eng (New York) v 89 n 10 May 17 1982 p 115-117
CODEN: CHEEA3
ISSN 0009-2460
This paper is concerned with the use of hydraulic force to transport solids through a pipeline. For any application, pressure drop is a key design parameter. This article presents pressure drop equations that are valid over the realistic range of hydraulic transport systems, and shows what information is needed to solve them. Since the equations are fairly accurate, they can be used for design purposes. The use of the developed method is illustrated by an example of coal slurry transportation. 4 refs.
DESCRIPTORS: (*FLOW OF FLUIDS, *Suspensions), (PIPING SYSTEMS, Design), (SOLIDS, Mixing), (LIQUIDS, Mixing), MATHEMATICAL TECHNIQUES, CHEMICAL PLANTS,
IDENTIFIERS: SLURRY TRANSPORTATION
CARD ALERT: 631, 619, 802, 921, 931

1283507 ID NO.- EI8207063507
SPECIFY SLURRY PUMPS FOR LONG LIFE AND MINIMUM MAINTENANCE.
Kuehl, John; Meadows, Michael
Warman Int Inc
Power v 125 n 10 Oct 1981 p 101-105 CODEN: POWEAD
ISSN 0032-5929
Slurry pumps used in flue-gas desulfurization (FGD) systems and in bottom ash-handling systems are described and their selection for particular tasks is facilitated by specifying than for different uses. For FGD applications four major design areas to be considered when specifying slurry pumps are discussed. They include the impeller, casing and liner, the bearing assembly, and pump-seal design. Furthermore, bearing-assembly design and pump seal design are briefly considered.
DESCRIPTORS: (*SLURRY PIPELINES, *Pumps), (PUMPS, Design),
CARD ALERT: 619, 618

1257274 ID NO.- EI8205037274
LONG-DISTANCE, HIGH-VOLUME TRANSPORT OF COAL BY SLURRY PIPELINE.
Stripling, T. E.; Holter, R. G.
Brown & Root Inc, Houston, Tex, USA
J Energy Resour Technol Trans ASME v 103 n 4 Dec 1981 p 322-329 CODEN: JERTD2
ISSN 0195-0738
Several long-distance, high-volume coal slurry transportation systems are planned or proposed for the United States. These new systems offer a method of transport that is both economical and environmentally attractive. The purpose special design considerations required for the overall system design considering the interrelationships of the various components. 51 refs.
DESCRIPTORS: (*COAL, *Pipelines), SLURRY PIPELINES,
CARD ALERT: 524, 619

1257273 ID NO.- EI8205037273
LAMINAR-TURBULENT TRANSITION IN PIPEFLOW OF CASSON MODEL FLUIDS.
Hanks, R. W.
Brigham Yound Univ, Provo, Utah, USA
J Energy Resour Technol Trans ASME v 103 n 4 Dec 1981 p 318-321 CODEN: JERTD2
ISSN 0195-0738
Methanol-coal slurries are known to behave as homogeneous non-Newtonian suspensions. Darby has shown that the Casson and Bingham models reasonably describe the rheology of methanol-lignite slurries. Theoretical methods are available for predicting critical velocities for Bingham model slurries, but none exist for Casson model slurries. Theoretical equations and design curves are derived and presented for Casson model slurries. These are based upon a proven general theory for transition critical velocities. These results are the essential first phase of a coordinated theory-based design method for transitional and turbulent flow of methanol-coal slurries and any other slurries having Casson-model rheology. 24 refs.
DESCRIPTORS: (*COAL, *Pipelines), SLURRY PIPELINES, (FLOW OF FLUIDS, Non Newtonian),
IDENTIFIERS: METHANOL-COAL SLURRIES
CARD ALERT: 524, 619, 631

1244878 ID NO.- EI8203024878
SLURRY PUMP DESIGN FEATURES.
Wilson, George
Worthington Can Inc, Brantford, Ont, Can
Min Eng (Littleton, Colo) v 33 n 10 Oct 1981 p 1450-1452
CODEN: MIENAB
ISSN 0026-5187
When pumping abrasive slurry mixtures, attention must be given to pump design and construction. The second article in this two-part series describes design features to consider when selecting centrifugal slurry pumps.
DESCRIPTORS: (*SLURRY PIPELINES, *Pumps),
CARD ALERT: 619, 618

1244875 ID NO.- EI8203024875
SLURRY PIPELINES. DESIGN, RESEARCH AND EXPERIENCE.
Thompson, T. L.; Aude, T. C.
Pipeline Syst Inc, Orinda, Calif
J Pipelines v 1 n 1 Jan 1981 p 25-44 CODEN: JOPIDT
This paper describes current slurry pipeline technology and classifies it within the overall pipeline field. Current commercial applications are summarized by length, number of pump stations, slurry characteristics, etc. Design procedures are discussed with emphasis on the boundaries of the current technology. 25 refs.
DESCRIPTORS: (*SLURRY PIPELINES, *Design), COAL, LIMESTONE,
CARD ALERT: 619, 524, 414, 482

1244874 ID NO.- EI8203024874
BOUGAINVILLE COPPER LIMITED CONCENTRATE PIPELINE - 8 YEARS OF SUCCESSFUL OPERATION.
Piercy, Paul; Cowper, Norman T.
Slurry Syst Pty Ltd, NSW, Aust
J Pipelines v 1 n 2 Aug 1981 p 127-138 CODEN: JOPIDT
Copper concentrate from Bougainville's copper mine located on the west slope of the Crown Prince Range on Bougainville Island, is pumped 27 km to the filter and drying plant at Anewa Bay for preparation and storage. The Bougainville pipeline is unique because it was designed by computer on the basis of laboratory tests, and it is the world's first copper concentrate system where slurry is pumped an appreciable distance against a high head. 5 refs.
DESCRIPTORS: (*SLURRY PIPELINES, *Design), COPPER DEPOSITS,
CARD ALERT: 619, 504

1228060 ID NO.- EI8201008060
ECONOMICS AND DESIGN OF SLURRY TANKERS.
Ghusn, A. E.
Fluor Min & Met, San Mateo, Calif, USA
Proc - Int Tech Conf on Slurry Transp, 5th, Lake Tahoe, Nev, USA, Mar 26-28 1980 Publ by Slurry Transp Assoc, Washington, DC, USA, 1980 p 53-61
Combination carriers are capable of lifting various cargoes, thus minimizing the length of ballast voyages. Behind mineral tanker design is the physical size of the very large crude carrier (VLCC) and ultra large crude carrier (ULCC). Equipped with a slurry system, a VLCC or ULCC can discharge an ore cargo at a monobuoy some distance from shore, via a submarine pipeline to the receiving facility.
DESCRIPTORS: (*TANKERS, *Ore Carriers), SLURRY PIPELINES, COAL TRANSPORTATION,
CARD ALERT: 671, 911, 619, 524, 434

1227286 ID NO.- EI8201007286
DESIGN AND DEVELOPMENT OF A HYDROTRANSPORT FACE HAULAGE SYSTEM USING A SELF REGULATING DRY FEED INJECTOR AND VENTILATED BOOST PUMPS.
Burnett, M.; Harvey, A. C.; Rubin, L. S.
Foster-Miller Assoc Inc, Waltham, Mass, USA
Proc - Int Tech Conf on Slurry Transp, 5th, Lake Tahoe, Nev, USA, Mar 26-28 1980 Publ by Slurry Transp Assoc, Washington, DC, USA, 1980 p 144-150
Hydraulic haulage has succeeded primarily where relatively steady state flow conditions can be maintained. A coarse solids injector pump and offspring boost pump are self controlling and self regulating and require no sumps, batching techniques or electronic controls to handle flow transients.
DESCRIPTORS: (*SLURRY PIPELINES, *Pumps), (ORE HANDLING, Pipelines),
CARD ALERT: 619, 618, 502, 691

1227284 ID NO.- EI8201007284
GEHO DIAPHRAGM PUMP - A NEW GENERATION OF HIGH-PRESSURE SLURRY PUMPS.
Holthuis, C. H.; Simons, P. W. H.
Holthuis, Neth
Hydrotransport 7: Pap Presented at the Int Conf on the Hydraul Transp of Solids in Pipes, 7th, Sendai, Jpn, Nov 4-6 1980. Publ by BHRA Fluid Eng, Cranfield, Bedford, Engl, 1980 p 17-32 CODEN: HYTRDM
This paper deals with the design criteria and development of a new type of positive displacement pump, the GEHO Piston Diaphragm Pump and gives a review of other high-pressure slurry pump systems available.
DESCRIPTORS: (*SLURRY PIPELINES, *Pumping Stations), (PUMPS, Diaphragms),
IDENTIFIERS: SLURRY PUMPS
CARD ALERT: 619, 618, 632

1227278 ID NO.- EI8201007278
KUDREMUKH IRON ORE CONCENTRATE SLURRY PIPELINE.
Wilk, A. S.; Green, W. H.; Pitts, J. D.; Vajda, J.; Wilson, C.; Hay, E.
Bechtel Inc, USA
Proc - Int Tech Conf on Slurry Transp, 5th, Lake Tahoe, Nev, USA, Mar 26-28 1980 Publ by Slurry Transp Assoc, Washington, DC, USA, 1980 p 24-33
This paper describes the system for transporting 7.5 million tonnes of iron ore concentrate in a 67-kilometer buried slurry pipeline, including a 2-kilometer tunnel, through difficult terrain in India. The system is the longest pipeline constructed to date in which motive force is provided by centrifugal pumps. The initial study, design, and procurement phases of the pipeline are discussed. 3 refs.
DESCRIPTORS: (*SLURRY PIPELINES, *India), (ORE HANDLING, Pipelines),
CARD ALERT: 619, 502, 691

1227277 ID NO.- EI8201007277
INFLUENCE OF NON-NEWTONIAN RHEOLOGY IN MIXED HOMOGENEOUS-HETEROGENEOUS SLURRY FLOW.
Hanks, Richard W.
Brigham Young Univ, Provo, Utah, USA
Proc - Int Tech Conf on Slurry Transp, 5th, Lake Tahoe, Nev, USA, Mar 26-28 1980 Publ by Slurry Transp Assoc, Washington, DC, USA, 1980 p 251-260
The effects of non-Newtonian slurry rheology on the critical velocity and on transitional and turbulent hydraulic resistance (friction factors) are discussed for the case of mixed slurries in which a combination of homogeneous and heterogeneous flow behavior is expected to occur. Some problems associated with neglect of these effects or of improperly accounting for them are pointed out. Methods for solving these problems are illustrated in an example pipeline design case. 19 refs.
DESCRIPTORS: (*SLURRY PIPELINES, *Flow), (ORE HANDLING, Pipelines),
CARD ALERT: 619, 631, 502, 691

1227274 ID NO.- EI8201007274
CAPSULE MOTION IN THE PILOT TEST PLANT FOR HYDRAULIC CAPSULE PIPELINES.
Yokogawa, A.; Suzuki, M.; Kinoshita, M.; Isaka, M.; Tachibana, T.
Tech Res Inst of Hitachi, Jpn
Hydrotransport 7: Pap Presented at the Int Conf on the Hydraul Transp of Solids in Pipes, 7th, Sendai, Jpn, Nov 4-6 1980. Publ by BHRA Fluid Engl, 1980 p 423-434 CODEN: HYTRDM
A middle-scale pilot test plant was constructed to obtain sufficient data for designing practical, large systems. This test plant consists of a loop pipeline (200 m long and 200 mm

theoretical calculations on the behavior of these stations. 2 refs.
DESCRIPTORS: (*SLURRY PIPELINES, *Flow), MATHEMATICAL MODELS, MATERIALS HANDLING,
CARD ALERT: 619, 631, 921, 691

1227258 ID NO.- EI8201007258
PIPELINE TERMINUS FINE COAL RECOVERY AND WATER CLARIFICATION USING A STATIC THICKENER.
Ackerman, John R.
Barrett, Haentjens & Co
Proc - Int Tech Conf on Slurry Transp, 5th, Lake Tahoe, Nev, USA. Mar 26-28 1980 Publ by Slurry Transp Assoc, Washington, DC, USA, 1980 p 215-221
This paper presents the possible uses of the HYDRA Hydraulic Rake static thickener in a coal transport pipeline system, a description of the mechanism results of static thickening and settling basin design.
DESCRIPTORS: *SLURRY PIPELINES, (COAL HANDLING, Pipelines),
IDENTIFIERS: HYDRA HYDRAULIC RAKE
CARD ALERT: 619, 524, 691

1227248 ID NO.- EI8201007248
OPERATING EXPERIENCE OF THE BLACK MESA PIPELINE.
Montfort, J. G.
Black Mesa Pipeline
Proc - Int Tech Conf on Slurry Transp, 5th, Lake Tahoe, Nev, USA, Mar 26-28 1980 Publ by Slurry Transp Assoc, Washington, DC, USA, 1980 p 16-23
The Black Mesa system consists of 273 miles (439 km) of mostly 18 in. (457 mm) pipeline, a slurry preparation plant and four reciprocating pumping stations which connects the Mohave Generating Station in southern Nevada to a Peabody Coal Company mine near Kayenta, Arizona. Design, operations and maintenance are reviewed.
DESCRIPTORS: *SLURRY PIPELINES, (COAL HANDLING, Pipelines),
CARD ALERT: 619, 524, 691

1227247 ID NO.- EI8201007247
PROCEEDINGS - INTERNATIONAL TECHNICAL CONFERENCE ON SLURRY TRANSPORTATION, 5TH, 1980.
Anon
Slurry Transp Assoc, Washington, DC, USA
Proc - Int Tech Conf on Slurry Transp, 5th, Lake Tahoe, Nev, USA, Mar 26-28 1980 Publ by Slurry Transp Assoc, Washington, DC, USA, 1980 296 p
This conference proceedings contains 37 papers, 28 of which are indexed separately. The papers are grouped into eight sessions: operating systems and proposed projects; ocean transport and terminals; non-conventional slurries; coarse coal transport; economics and utilization design criteria; slurry preparation and dewatering; technical aspects; and pumps.
DESCRIPTORS: *SLURRY PIPELINES, (COAL HANDLING, Pipelines), ORE HANDLING,
CARD ALERT: 619, 524, 691, 502

1194951 ID NO.- EI811194951
ADEQUATE SLURRY PIPELINE DESIGN TECHNOLOGY EXISTS.
Steindorff, Gerald N.
Gulf Interstate Eng Co, Houston, Tex
Oil Gas J v 78 n 51 Dec 22 1980 p 76-77, 79-80 CODEN: OIGJAV
ISSN 0030-1388
A discussion is presented of factors relative to slurry design, slurry preparation, pipeline design, slurry separation and recovery, economics, and slurry pipeline materials.
DESCRIPTORS: (*SLURRY PIPELINES, *Design),
CARD ALERT: 619

1152666 ID NO.- EI810652666
UNIQUE ASPECTS OF SLURRY PIPELINES.
Steindorff, G. N.
Gulf Interstate Eng Co, Houston, Tex
ASME Pap n 80-WRK/Pet-3 for Meet Sep 14-16 1980 5 p CODEN: ASMSA4
ISSN 0402-1215
Although slurry pipeline systems have been utilized for over 80 years to transport solids via pipeline, slurry pipeline growth has been relatively slow in comparison to conventional liquid pipelines. This is due to more complex technology and limited conditions for attaining economic viability of slurry pipeline systems. The unique aspects of design, materials, construction, and operation of slurry pipeline systems can be compared to conventional liquid pipeline systems to demonstrate that techniques have been developed to successfully design, construct, and operate slurry pipeline transportation system.
DESCRIPTORS: (*SLURRY PIPELINES, *Economics), COAL TRANSPORTATION,
CARD ALERT: 619, 524

1152665 ID NO.- EI810652665
LONG DISTANCE, HIGH VOLUME TRANSPORT OF COAL BY SLURRY PIPELINE.
Stripling, T. E.; Holter, R. G.
Brown & Root Inc, Houston, Tex
ASME Pap n 80-WRK/Pet-1 for Meeting Sep 14-16 1980 11 p CODEN: ASMSA4
ISSN 0402-1215
Several long distance, high volume coal slurry transportation systems are planned or proposed for the United States. These new systems offer a method of transport that is both economical and environmentally attractive. The purpose of this paper is to describe the system components of a large coal slurry transportation system in detail and to show the special design considerations required for the overall system design considering the interrelationships of the various components. 51 refs.
DESCRIPTORS: (*SLURRY PIPELINES, *Economics), COAL TRANSPORTATION,
CARD ALERT: 619, 524

1151483 ID NO.- EI810651483
RUBBER LINED PIPELINES $EM DASH$ AN OVERVIEW.
Hay, E.; Jackson, L. D. A.
Alcan Int Ltd, Montreal, Que
ASME Pap n 80-WA/MH-8 for Meet Nov 16-21 1980 9 p CODEN: ASMSA4
ISSN 0402-1215
The reduction of erosion and wear by the rubber lining of pipelines is well established, especially for iron ore slurry transportation. The paper gives an overview of the current development of linings and their relative merits on performance. A typical slurry transportation system is briefly described and various mechanical design features such as jointing, fittings and line flexibility are discussed. Examples and special experience are given concerning cross country pipelines in Canada and India. 8 refs.
DESCRIPTORS: (*PIPELINES, *Lining), RUBBER, ORE HANDLING,
IDENTIFIERS: IRON ORE SLURRY TRANSPORTATION
CARD ALERT: 619, 818, 502, 691

1146928 ID NO.- EI810646928
EVALUATION OF COARSE COAL HYDROTRANSPORT DATA AND PREDICTIVE MODELS.
Lombardo, N. J.; Eyler, L. L.
Battelle, Pac Northwest Lab, Richland, Wash
Unit and Bulk Mater Handl, Presented at Mater Handl Conf, ASME Century 2 - Emerging Technol Conf, San Francisco, Calif, Aug 19-21 1980 Publ by ASME, New York, NY, 1980 p 135-142
An experimental program was conducted by the Pittsburgh Mining Technology Center of the U. S. Department of Energy (DOE) in the early 1970s to provide coarse particle design data. This research effort was conducted by the U. S. Bureau of Mines (BOM) at its Pittsburgh Mining and Safety Research Center. A description of the 15. 24 cm diameter experimental hydrotransport facility is presented in this paper. An independent evaluation of the data was accomplished through a comparison of the data with several recently published prediction methods. In this paper, an evaluation and comparison of these methods and the data are presented.
DESCRIPTORS: *COAL TRANSPORTATION, (FLOW OF FLUIDS, Suspensions), PIPELINES, MATHEMATICAL MODELS,
IDENTIFIERS: HYDRAULIC TRANSPORT, SLURRY TRASPORT
CARD ALERT: 524, 631

1146927 ID NO.- EI810646927
HYDRAULIC TRANSPORT RESEARCH FACILITY FOR COARSE COAL.
Faddick, R. R.; Miscoe, A. J.
Colo Sch of Mines, Golden
Unit and Bulk Mater Handl, Presented at Mater Handl Conf, ASME Century 2 - Emerging Technol Conf, San Francisco, Calif, Aug 19-21 1980 Publ by ASME, New York, NY, 1980 p 125-133
A research program hs been designed for the operation of the newly constructed Hydraulic Transport Research Facility (HTRF). The program is designed to obtain engineering data for the design of efficient, economical, and reliable raw coal hydraulic haulage systems for the mine face to the wash plant. A five-year experimental design consisting of three phases has been developed. Phase I tests three pipeline diameters with both a washed and unwashed coal at varying slurry concentrations. Phase II allows for implementation of a data logger for examination of the effects of particle size distribution and flow transients. Phase III comprises a definitive study on transients and particle size, with different coals and coal-refuse mixtures.
DESCRIPTORS: *COAL TRANSPORTATION, PIPELINES, (FLOW OF FLUIDS, Suspensions),
IDENTIFIERS: HYDRAULIC TRANSPORT, SLURRY TRANSPORT
CARD ALERT: 524, 619, 631

1140535 ID NO.- EI810540535
CORRELATION OF TURBULENT FLOW RATE-PRESSURE DROP DATA FOR NON-NEWTONIAN SOLUTIONS AND SLURRIES IN PIPES.
Int J Multiphase Flow v 6 n 6 Dec 1980 p 553-561 CODEN: IJMFBP
ISSN 0301-9322
Isothermal and non-isothermal flow rate-pressure drop data in turbulent flow through smooth pipes have been obtained for non-Newtonian fluids, including aqueous solutions of polymers and aqueous suspensions of titanium dioxide. It has been established that the friction factor is a function of a new form of Reynolds number. 12 refs.
DESCRIPTORS: (*FLOW OF FLUIDS, *Turbulent), (SLURRY PIPELINES, Design),
CARD ALERT: 631, 619

1136102 ID NO.- EI810436102
COAL/OIL MIXTURE PIPELINE: A VIABLE ALTERNATIVE COAL TRANSPORTATION SYSTEM?
Harkness, J. B. L.; Petrovic, L. J.
Argonne Natl Lab, USA
Int Symp on Coal-Oil Mixture Combust, 2nd, Danvers, Mass, Nov 27-29 1979 v 2. Sponsored by DOE, Pittsburgh Energy Technol Cent (CONF-791160 - vol 2), Pa, 1979. Available from NTIS, Springfield, Va 18 p
In this paper, a coal transportation system which utilizes coal/oil mixture technology is compared to the coal/water system and to another alternative, coal/methanol system. The primary considerations addressed are the system design considerations and tradeoffs, the resource requirements (including capital) and the cost of delivered energy. Considerations such as the system environmental impacts, the status of the technologies, oil quality and supply, and the potential system flexibilities are discussed qualitatively.
DESCRIPTORS: *SLURRY PIPELINES, (BOILER FIRING, Multiple Fuel),
CARD ALERT: 619, 614

1130651 ID NO.- EI810430651
INTERNATIONAL SYMPOSIUM ON COAL-OIL MIXTURE COMBUSTION, 2ND, 1979.
Anon
DOE, Pittsburgh Energy Technol Cent, Pa
Int Symp on Coal-Oil Mixture Combust, 2nd, Danvers, Mass, Nov 27-29 1979 Sponsored by DOE, Pittsburgh Energy Technol Cent (CONF-791160), Pa, 1979. Available from NTIS, Springfield, Va 2 vol var pagings
This conference proceedings contains 46 papers on the combustion of mixtures of pulverized coal in fuel oil as a means of reducing oil consumption. Topics discussed include the current status of coal-oil mixture (COM) research programs in the United States, Canada, Japan and the People's Republic of China; demonstration projects of COM combustion in utility boilers and COM injection into blast furnaces; the stability and pumping characteristics of coal/fuel oil dispersions; the grinding coal-in-oil slurries; the feasibility of using coal/oil/water emulsion and coal/oil mixtures as clean liquid fuels; the rheological properties of solvent-refined coal-oil mixtures; the stabilization of coal/fuel oil slurries; the atomization of coal slurry jets; carbonaceous fuel-in-oil suspensoids; and the design of a coal/oil slurry pipeline. 14 papers are indexed separately.
DESCRIPTORS: (*BOILER FIRING, *Multiple Fuel), (FUELS, Combustion), (PULVERIZED FUEL, Combustion), SUSPENSIONS, EMULSIONS,
IDENTIFIERS: COAL/OIL SLURRIES
CARD ALERT: 614, 521, 524, 804

1118453 ID NO.- EI810218453
SLURRY PIPELINE HYDRAULICS: PRINCIPLES, PROBLEMS AND SOLUTIONS.
Hanks, R. W.
Brigham Young Univ, Provo, Utah
ASME Pap n 80-Pet-45 for Meet Feb 3-7 1980 10 p CODEN: ASMSA4
ISSN 0402-1215
Pipe diameters, slurry velocity, solids concentration, particle size distributions, hydraulic grades, pump sizes, and many other variables enter into the design of a slurry pipeline. Of special importance are critical velocity and hydraulic resistance. Economics require high solids concentrations with size distributions high in fines to provide slurries with good pumping characteristics and high solids transport rate. Proper design methods are presented and illustrated by an example pipeline design. 22 refs.
DESCRIPTORS: (*SLURRY PIPELINES, *Design), PIPELINES, (HYDRAULICS, Theory), FLOW OF FLUIDS,
CARD ALERT: 619, 632, 631

1118451 ID NO.- EI810218451
PROBLEMS IN THE FLUID MECHANICS OF PIPELINE SYSTEMS FOR HYDRAULIC TRANSPORT OF SOLID MATERIALS.
Olofinskii, E. P.
Power Eng (New York) v 17 n 4 1979 p 24-30 CODEN: POENDL
ISSN 0160-5216
Certain problems in the fluid mechanics of inhomogeneous media are considered in terms of the possibility of validating the fundamental technical parameters in the design of trunk pipeline systems for hydraulic transport of solid materials. Various approaches are analyzed for the study of pressurized flows of multiphase media. Experimental data obtained with the aid of pipe installations and viscosimeters in the investigation of highly concentrated hydraulic mixtures with Kansk-Achinskii lignite are discussed.
DESCRIPTORS: *SLURRY PIPELINES, COAL TRANSPORTATION, (LIGNITE, Transportation),
CARD ALERT: 619, 524

1093902 ID NO.- EI801293902
NEW TECHNIQUES FOR THE SCALE-UP OF PILOT-PLANT RESULTS TO COAL SLURRY PIPELINES.
Wilson, K. C.; Kudge, D. G.
Queen's Univ, Kingston, Ont
J Powder Bulk Solids Technol v 4 n 1 Jan 1980 p 15-22 CODEN: JPBTDX
ISSN 0147-698X
Design of the new generation of large-diameter coal slurry pipelines requires improved scale-up techniques. A recently-developed analysis, based on the physical mechanisms of solid-liquid flow, can be used for this purpose. This analysis is a general one, and does not require that the flow be classified into any particular regime. Pressure gradient, and hence specific energy consumption, is divided into suspended and contact load components. Each component is scaled up separately by the analytic model, and prototype behavior is then obtained by recombination of the components. As a practical matter, scale-up should concentrate on the conditions near the optimum operating point, and it is found that coal slurries suitable for long-distance pipelining have an optimum velocity virtually coinciding with the limit of deposition. For this type of behavior the analytically-determined scaling relations for the optimum can be closely approximated by power laws which have exponents that are rather insensitive to changes in pipe diameter or particle properties. 14 refs.
DESCRIPTORS: *SLURRY PIPELINES,
CARD ALERT: 619

1093898 ID NO.- EI801293898
SLURRY PIPELINE TECHNOLOGY $EM DASH$ AN ASSESSMENT.
Gandhi, R. L.; Snoek, P. E.
Bechtel Inc, San Francisco, Calif
Polyphase Flow and Transp Technol, Presented at the Symp on Polyphase Flow and Transp Technol, Century 2 - Emerging Technol Conf, San Francisco, Calif, Aug 13-15 1980 Publ by ASME, New York, NY, 1980 p 17-26
A number of slurry pipelines are in operation in various parts of the world. Considerable progress has been made in developing the slurry pipeline technology from an art to an empirical science. In this paper the status of the slurry pipeline technology is summarized. The flow behavior of solid-liquid suspensions is governed by the properties of the slurry as well as the conditions of flow. The effect of different types of flow behavior on the design of slurry pipeline system and selection of mechanical equipment are examined. The areas in which further research is needed are pointed out. 29 refs.
DESCRIPTORS: *SLURRY PIPELINES, (FLOW OF FLUIDS, Two Phase), COAL TRANSPORTATION,
CARD ALERT: 619, 631, 524

1092788 ID NO.- EI801292788
SLURRY PIPELINE DESIGN WITH GEOMETRIC PROGRAMMING
Rasey, Steven M.; Faddick, Robert R.
Colo Sch of Mines, Golden
ASCE Transp Eng J v 106 n 6 Nov 1980 p 815-827 CODEN: TPEJAN
ISSN 0569-7891
The objective of pipeline design is the selection of pumping station sites, pipe diameters, and pipe wall thicknesses economically over the length of the pipeline with regard to the pressures within the pipe. A new technique in nonlinear optimization called geometric programming offers a fast and inexpensive way to design a pipeline as a function of project costs and pipeline pressures. Once the characteristics of the fluid and the terrain have been incorporated into the model, a digital computer quickly solves the geometric program. Some recent studies show that for long distance coal slurry pipelines in mountainous terrain, additional pumping stations and changing pipe outer diameters may be cost beneficial. An additional pumping station may reduce the static pressure in a substantial length of pipeline which decreases the cost of the pipe. 3 refs.
DESCRIPTORS: (*PIPELINES, *Pumping Stations), COMPUTER PROGRAMMING, OPTIMIZATION, COAL TRANSPORTATION,
IDENTIFIERS: SLURRY PIPELINES, GEOMETRIC PROGRAMMING
CARD ALERT: 619, 618, 632, 723, 921, 524

1087805 ID NO.- EI801287805
TECHNO-ECONOMIC STUDY FOR THE HYDRAULIC TRANSPORTATION OF BAUXITE ORE
Kumar, H. F
Indian Inst of Technol, New Delhi
J Powder Bulk Solids Technol v 4 n 1 Jan 1980 p 23-29
CODEN: JPBTDX
ISSN 0147-698X
Results of a techno-economic study for the hydraulic transportation of bauxite ore in the form of a slurry over a distance of approximately 73 km are discussed. Detailed pilot plant studies have been conducted in a 50 mm pipe loop with water and 170 gpl caustic liquor as carrier fluids. The effect of aging on the rheological behavior of the bauxite slurry has been investigated. Based on the results from a pilot plant study, a detailed design and economic analysis for pipeline was conducted.
DESCRIPTORS: *BAUXITE ORE TREATMENT, SLURRY PIPELINES,
CARD ALERT: 533, 619

1077431 ID NO.- EI801077431
BRAZIL'S VALEP PROJECT $EM DASH$ PHOSPHATE SLURRY LINE COMPLETES FIRST YEAR WITH EXCELLENT RECORD.
Fister, Lynn C.; Finerty, Brian C.; Hill, Richard A.
Bechtel Inc, USA
Pipe Line Ind v 52 n 4 Apr 1980 p 51-54 CODEN: PLINAH
ISSN 0032-0145
The authors describe the precedent-setting project, which includes an open pit mine, concentrator, 75-mile, 9-inch pipe line with pump station and orifice station, and terminal facilities at the complex. The line was designed on the basis of bench scale tests used in conjunction with computer models.
DESCRIPTORS: (*PIPELINES, *Design), PHOSPHATES,
IDENTIFIERS: PHOSPHATE SLURRY PIPELINES
CARD ALERT: 619, 901, 804

1071092 ID NO.- EI800971092
NATIONAL COAL BOARD'S PILOT PLANT FOR SOLIDS PUMPING AT HORDEN COLLIERY.
Paterson, A. C.; Watson, N.
Bullen & Partners, UK
Hydrotransport 6 v 1, Pap Presented at the Int Conf on the Hydraul Transp of Solids in Pipes, 6th, Univ of Kent, Canterbury, Engl, Sep 26-28 1979. Publ by BHRA Fluid Eng, Cranfield, Bedford, Engl, 1979 p 353-366 CODEN: HYTRDM
A pilot plant for the hydrotransport of colliery waste has been constructed at Horden Colliery, U. K. The first stage has a pipeline length of 1. 2 km and a nominal bore of 250 mm, and the next stage is the construction of an additional 500 mm of submarine pipeline out into the North Sea. This paper describes the design and construction of the plant, the operating experience and lessons learned.
DESCRIPTORS: (*SLURRY PIPELINES, *Pumps), HYDRAULIC MACHINERY.
CARD ALERT: 619, 632

1071078 ID NO.- EI800971078
DESIGN OF PIPELINE FOR A HIGHLY ABRASIVE AND CORROSIVE SLURRY.
Nguyen, V. T.; Saez, F.
DTP, Fr
Hydrotransport 6 v 1, Pap Presented at the Int Conf on the Hydraul Transp of Solids in Pipes, 6th, Univ of Kent, Canterbury, Engl, Sep 26-28 1979. Publ by BHRA Fluid Eng, Cranfield, Bedford, Engl, 1979 p 367-378 CODEN: HYTRDM
This study presents the main results of a study program for designing adequate technical solutions for a copper tailings transportable system. The pipeline is designed to connect a mineral flotation plant to a tailings dam. The distance exceeds 35 miles. The annual capacity $EM DASH$ more than 40 million cubic meters i. e. 25 million tons of dry product $EM DASH$ is one of the highest in the field of solid pipelining. The copper tailings to be transported are highly abrasive and corrosive due to the high proportion of sand and to their acid content. A long study program was carried out: rheology study, hydraulic tests on pilot station, abrasion tests, internal protection design, and special devices for choke stations.
DESCRIPTORS: (*SLURRY PIPELINES, *Design), COPPER DEPOSITS.
CARD ALERT: 619, 504

1071077 ID NO.- EI800971077
HYDRAULIC TRANSPORT SYSTEMS IN THE MINING INDUSTRY USING JET SLURRY PUMPS.
Debreczeni, E.; Tarjan, I.; Meggyes, T.
Tech Univ of Heavy Ind, Miskolc, Hung
Hydrotransport 6 v 1, Pap Presented at the Int Conf on the Hydraul Transp of Solids in Pipes, 6th, Univ of Kent, Canterbury, Engl, Sep 26-28 1979. Publ by BHRA Fluid Eng, Cranfield, Bedford, Engl, 1979 p 315-328 CODEN: HYTRDM
Jet pumps are generally suitable to be applied for solving material handling tasks when simple construction, low investment costs and great safety of operation are required in the first place, while energy consumption is of no major importance. Typical transport tasks occurring in this field are short distance or periodic conveyance of solids, transport made for safety reasons, and feeding of solids into high capacity slurry transport systems. Technical solutions and technological schemes are given in the study for the tasks described. The determination of the main technical parameters, the way of operation and the construction of the most important equipment are dealt with. Finally, the advantages achieved by the described equipment and technologies are analyzed. 5 refs
DESCRIPTORS: (*SLURRY PIPELINES, *Design), PUMPS, JET, MINES AND MINING.
CARD ALERT: 619, 618, 502

1071076 ID NO.- EI800971076
FLOW CHARACTERISTICS OF GOLD MILL TAILINGS AND DESIGN OF AN UNDERGROUND HYDRAULIC BACKFILLING SYSTEM.
Mukherjee, S. K.; Thakur, D. N.
Cent Min Res Stn, Dhanbad, India
Hydrotransport 6 v 1, Pap Presented at the Int Conf on the Hydraul Transp of Solids in Pipes, 6th, Univ of Kent, Canterbury, Engl, Sep 26-28 1979. Publ by BHRA Fluid Eng, Cranfield, Bedford, Engl, 1979 p 243-256 CODEN: HYTRDM
Results of friction losses occurring during the flow of mill tailings slurry of a gold mine in 130 mm, 105 mm and 80 mm bore pipelines at different velocities and concentrations are presented. An equilibrium equation has been derived for the flow of the slurry under gravity in a combination of vertical and horizontal pipeline. Based on this equation, a method of calculating the optimum concentration and optimum rate of slurry flow for an underground filling system through pipeline under gravity has been discussed. 2 refs.
DESCRIPTORS: (*SLURRY PIPELINES, *Design), (FLOW OF FLUIDS, Pressure Measurement).
CARD ALERT: 619, 631

1071075 ID NO.- EI800971075
HYDROTRANSPORT 6, VOLUME 1: PAPERS PRESENTED AT THE INTERNATIONAL CONFERENCE ON THE HYDRAULIC TRANSPORT OF SOLIDS IN PIPES, 6TH, 1979.
Stephens, H. S. (Ed.); Gittins, Lavinia (Ed.)
BHRA Fluid Eng, Cranfield, Bedford, Engl
Hydrotransport 6 v 1, Pap Presented at the Int Conf on the Hydraul Transp of Solids in Pipes, 6th, Univ of Kent, Canterbury, Engl, Sep 26-28 1979. Publ by BHRA Fluid Eng, Cranfield, Bedford, Engl, 1979 404 p CODEN: HYTRDM
This conference contains 31 papers, 30 of which are abstracted separately. The subject matter is primarily concerned with the design and related equipment for slurry pipelines. Associated activity such as blast furnace practice and mining methods are discussed. Characteristics of suspensions in fluid flow are analyzed.
DESCRIPTORS: (*SLURRY PIPELINES, *Design), (FLOW OF FLUIDS, Suspensions), FLOWMETERS, COAL RESEARCH, (BLAST FURNACE PRACTICE, Fuel Injection), (MINES AND MINING, Hydraulic Equipment),
CARD ALERT: 619, 631, 943, 521, 533, 502

1071074 ID NO.- EI800971074
CRITICAL SLOPE FOR SLURRY PIPELINE TRANSPORTING COAL AND OTHER SOLIDS PARTICLES.
Kao, D. T. Y.; Hwang, L. Y.
Univ of Ky, Lexington
Hydrotransport 6 v 1, Pap Presented at the Int Conf on the Hydraul Transp of Solids in Pipes, 6th, Univ of Kent, Canterbury, Engl, Sep 26-28 1979. Publ by BHRA Fluid Eng, Cranfield, Bedford, Engl, 1979 p 57-74 CODEN: HYTRDM
The lack of information concerning the engineering design criteria of an inclined slurry pipeline has in fact caused engineers to design it with caution and operate with uncertainty. Extra safety considerations have lead to the adoption of extremely stringent slope limitation for designing slurry pipelines on grade. This will mean larger construction costs and greater capital expenses in terms of using more lengths of pipes, in case of establishing a slurry transport system over a relatively rugged terrain in a mountainous area. In this study analytical and experimental analyses were initiated to understand better the flow behavior of solid-liquid slurries in an inclined pipe. 7 refs.
DESCRIPTORS: (*SLURRY PIPELINES, *Construction), (FLOW OF FLUIDS, Suspensions), COAL TRANSPORTATION,
CARD ALERT: 619, 631, 524

1046317 ID NO.- EI800646317
SLURRY TRANSPORTATION IN PIPELINES SEM DASH$ A COMPUTER MODEL FOR HYDRAULIC BACKFILLING SYSTEMS.
Mozumdar, B. K.; Ghose, A. K.
Indian Scb of Mines, Dhanbad
J Mines Met Fuels v 27 n 4 Apr 1979 p 101-105 CODEN:
ISSN 0022-2755
Applications of computer to the study of hydraulic backfilling systems have been relatively few. Gyenge and Coates developed a computer program for the optimization of simplified mine-fill transportation system; Rabsztyn presented a computer program for the design of hydraulic backfilling installations in Polish coal mines. This paper examines some of the more important empirical relationships for prediction of slurry flow behavior vis-a-vis gravity induced flow of slurries in hydraulic backfilling installations. A computer model for analyzing the throughput of a backfill installation using different empirical approaches is described and, finally, the results of a computer run for a hypothetical case are presented. 7 refs.
DESCRIPTORS: (*MINES AND MINING, *Hydraulic Process), (COAL MINES AND MINING, Hydraulic Process), (SLURRY PIPELINES, Applications), COMPUTER PROGRAMS,
IDENTIFIERS: HYDRAULIC BACKFILLING
CARD ALERT: 502, 504, 632, 503, 619, 723

1040602 ID NO.- EI800540602
MATERIALS HANDLING BY SLURRY PIPELINES (CITATIONS FROM THE ENGINEERING INDEX DATA BASE).
Hundemann, Audrey S. (Ed.)
NTIS, Springfield, Va
NTISearch NTIS/PS-79/0848/6EES, Search period covered: 1970-Jul 1979. Publ by NTIS, Springfield, Va, Aug 1979. Available from NTIS 241 p CODEN: NTISDZ
Worldwide research on slurry pipelines carrying coal, crude oil, minerals, sand, gravel, metallic ores, industrial wastes, and municipal wastes is cited. Studies on pumps, pipes, fluid flow, hydraulics, and design are included. Characteristics of transported materials are covered. Underwater pipelines and underground pipelines are also covered. This updated bibliography was prepared by searching the 1970-July 1979 data base of Engineering Index. It contains 241 abstracts, 38 of which are new entries to the previous edition.
DESCRIPTORS: (*SLURRY PIPELINES, *Bibliographies), (MATERIALS HANDLING, Pipelines),
CARD ALERT: 619, 691

1039385 ID NO.- EI800539385
OPTIMAL DESIGN OF PIPELINE NETWORKS CARRYING HOMOGENEOUS COAL SLURRY.
Ulusoy, Ahmet G.; Miller, David M.
Bogazici Univ, Istanbul, Turk
Math Program Study n 11 Oct 1979 p 85-107 CODEN: MPSTDF
ISSN 0303-3929
The problem considered is that of obtaining the least cost design of a pipeline network supplying demand points with known demand functions for dry solids from a single source over a finite time horizon. The variables of optimization are the network configuration, the flow rate, the diameter of the pipe, and the volumetric concentration of solids in the slurry. The objective function is formulated as an annual total cost expression incorporating pipe, pump, pump motor, and operation and maintenance costs of the system. The problem is decomposed into a network problem and a subproblem which is the optimum design of a single arc at a given flow rate level. An efficient solution method making use of monotocity relationships of the decision variables is developed for the single line problem. To solve the network problem an implicit enumeration method searching over adjacent arborescences and making extensive use of the subproblem is proposed. A local optimum is defined and the solution procedure is shown to converge to this local optimum in a finite number of iterations. Numerical experience with the algorithm is included. 24 refs.
DESCRIPTORS: (*PIPELINES, *Computer Aided Design), OPTIMIZATION, FLOW OF SOLIDS, MATHEMATICAL PROGRAMMING,
CARD ALERT: 619, 723, 921, 931

1032128 ID NO.- EI800432128
DEVELOPMENT OF A HIGH-PRESSURE, CENTRIFUGAL SLURRY PUMP.
Wong, G. S.; Gilman, H. H.; Davis, O. E.
Rockwell Int, Canoga Park, Calif
Chem Eng Prog v 75 n 12 Dec 1979 p 58-65 CODEN: CEPRA8
ISSN 0009-2495
In view of ever-increasing energy needs, considerable attention has been given to the commercialization of coal conversion processes. Many of these, such as Solvent Refined Coal (SRC-I, SRC-II), Exxon Donor Solvent (EDS), H-Coal, and Synthoil $EM DASH$ which convert coal to clean liquid fuels $EM DASH$ and Bi-Gas and Hygas $EM DASH$ which convert coal to clean pipeline gases $EM DASH$ will need specialized equipment before full commercialization can be realized. Among the equipment required is a high-capacity, high-pressure centrifugal slurry feed pump to supply a coal-oil slurry mix to a high-pressure reactor or gasifier in the liquefaction or gasification of coal. This paper reports on engineering design studies and experimental material studies which indicate that the design of a high-capacity, high-pressure, multistage centrifugal pump for commercial size, coal liquefaction plants is feasible. Based on optimized hydraulic design and experimental material erosion tests, centrifugal slurry pumps with increased wear of life at impeller tip speed over twice the current state of the art are achievable. An engineering evaluation of multistage pump concepts and slurry pumping requirements further indicates that a two-stage pump module is a promising and viable pump concept that can be used effectively to meet all the operating requirements. 10 refs.
DESCRIPTORS: (*PUMPS, CENTRIFUGAL, *Design), CHEMICAL PLANTS, (COAL LIQUEFACTION, Equipment),
IDENTIFIERS: HIGH-PRESSURE CENTRIFUGAL PUMPS FOR SLURRY
CARD ALERT: 618, 523, 524, 601, 802

1030377 ID NO.- EI800430377
KUDREMUKH IRON CONCENTRATE SLURRY PIPELINE $EM DASH$ NORTH AMERICAN TECHNOLOGY IN DEVELOPING COUNTRIES.
Vajda, J.; Wilson, C.; Hay, E.; Wilk, A. S.; Green, W. N.; Pitts, J. D.
ASME Pap n 79-WA/MH-6 for Meet Dec 2-7 1979 10 p CODEN: ASMSA4
ISSN 0402-1215
This paper briefly describes the system for mining, crushing, concentrating and, finally, filtering 7.5 million tonnes of iron ore per year in India. The iron ore concentrate is transported from site to the shipping area in a 67-km buried slurry pipeline through inaccessible mountains and difficult terrain. The system, rated at a maximum design throughput of nearly 1700 dry tonnes per hour, will be the largest capacity long-distance slurry pipeline in the world. The initial study, design, procurement and construction phases of the pipeline are discussed with emphasis on key implementation decisions during each phase and problem areas. Particular emphasis is placed on the considerations surrounding transfer of North American technology to developing countries. 2 refs.
DESCRIPTORS: (*IRON MINES AND MINING, *Piping Systems), (SLURRY PIPELINES, Design),
CARD ALERT: 504, 502, 619

1021994 ID NO.- EI800321994

KUDREMUKH IRON CONCENTRATE SLURRY PIPELINE NORTH AMERICAN TECHNOLOGY IN DEVELOPING COUNTRIES.

Vajda, J.; Wilson, C.; Hay, E.; Wilk, A. S.; Green, W. N.; Pitts, J. D.

MET-CHEM, Montreal, Que

ASME Pap n 79-WA/MH-6 for Meet Dec 2-7 1979 10 p CODEN: ASMSA4

ISSN 0402-1215

This paper briefly describes the system for mining, crushing, concetrating and, finally, filtering 7. 5 million tons of iron ore per year in India. The iron ore concentrate is transported form site to the shipping area in a 67-km buried slurry pipeline through inaccessible mountains and difficult terrain. The system, rated at a maximum design throughput of nearly 1700 dry tons per hour, will be the largest capacity long-distance slurry pipeline in the world. The initial study, design, procurement and construction phases of the pipeline are discussed with emphasis on key implementation decisions during each phase and problem areas. Particular emphasis is placed on the considerations surrounding transfer of North American technology to developing countries. 2 refs.

DESCRIPTORS: (*IRON ORE TREATMENT, *India), (SLURRY PIPELINES, Applications),

CARD ALERT: 533, 619

1018905 ID NO.- EI800318905

SLURRY TRANSPORTATION IN A COAL PREPARATION PLANT.

Albrecht, M. C.

Kaiser Eng, Inc, Oakland, Calif

ASME Pap n 79-WA/MH-9 for Meet Dec 2-7 1979 5 p CODEN: ASMSA4

ISSN 0402-1215

Coal preparation and coal characteristics that affect coal preparation are discussed in detail. This discussion then leads to the application of slurry transport principles to a coal preparation plant. Slurry transport is analyzed from an operator's viewpoint, considering the problem areas caused by the improper use of slurry technology by the design engineer. These problem areas are viewed from what the operator has learned to expect and how he ultimately handles them. The paper concludes with a discussion of how sound slurry and coal preparation principles can be integrated.

DESCRIPTORS: (*COAL TRANSPORTATION, *Control), (SLURRY PIPELINES, Applications),

CARD ALERT: 524, 619

SLURRY PIPELINE STANDARDS

Print 19/5/1 2334
DIALOG File8: COMPENDEX - 70-83/Jan (Copr. Engineering Information Inc.) (Item 1 of 1) User 1446 9mar83

457405 ID NO.- EI740957405

CORROSION STANDARDS AND CONTROL IN THE PIPELINE INDUSTRY.

Peabody, A. W.
Ebasco Serv Inc, New York, NY

ASTM Spec Tech Publ 534, 1973, p 89-106 CODEN: ASTTA8

The discussion concerns itself with any pipeline used for the transportation of materials. Materials involved can include, but are not necessarily limited to, fuel gas, petroleum and petroleum products, water, chemical solutions, effluents from manufacturing plants, and solids being transported in slurry form. The pipeline industry is a very high investment industry. Fully implemented corrosion control can effect high dollar savings by reducing property loss, by reducing the cost of repairs, by avoiding catastrophic failures with loss of property and life, and by conservation of natural resources as the energy shortage crisis becomes ever more serious. There are effective methods of corrosion control which are available for both the external surfaces of a pipeline and for its internal surfaces where they are required. The most important of these methods are described in detail.

DESCRIPTORS: (*PIPELINES, *Corrosion), CORROSION PROTECTION, CATHODIC,
CARD ALERT: 539, 619

Print 16/5/1-8
DIALOG File14: ISMEC: Mechanical Engineering - 73-83/Jan (Copr. Cambridge Sci. Abs.) (Item 1 of 8) User 1446 9mar83

111528 D80013521 Slurry Pipeline Design
Slurry pumps and wear analysis: considerations for system designers, pump specifiers and operators
Colley, A.
Worthington (Canada) Ltd., Canada
Combustion Vol. 52, No. 1 42-49 Jul 1980 Coden: ENFIAG
Journal Addr: USA
Treatment: D; I; C
Document Type: 02
Descriptors: Abrasives; Wear; Design; Materials; Pumps
Identifiers: slurry pumps; positive displacement pumps; piston pumps; plunger pumps; oil barrier piston pumps; progressive cavity pumps; twin screw pumps; wear types; partical properties; slurry properties; pump contact materials ; applications; slurry pipelines
Class Codes: D5540

102855 D80004848 Slurry Pipeline Design
Wear in slurry pipelines (wear types, metals, case history statistics)
Want, F. M.
Alcoa of Australia Ltd., Pinjarra Refinery, Australia
Transactions of the Institution of Engineers, Australia, Mechanical Engineering Vol. ME4 17-27 Nov 1979
Journal Addr: Australia
Treatment: P; T; A
Document Type: 02
(21 Refs)
Descriptors: Wear; Abrasion; Failure (mechanical); Pipelines
Identifiers: slurry; liquid phase; solid phase; slurry mixture; metals; iron; stainless steel; steel; design; wear resistance; wear types; spiral flow; flashing; sloping pipes; flange joints; computational methods; statistics; case histories; wear rates
Class Codes: D6710; D3650; D7300

091597 D79008590 Slurry Pipeline Design
Materials handling: Abstracts (7) of papers presented at the ASME meeting Dec. 10-15, 1978
Mechanical Engineering Vol. 101, No. 5 97-98 May 1979 Coden: MEENAH
USA
Treatment: B
Document Type: 13
Descriptors: Belt conveyors; Pipelines; Transportation; Coal ; Conveyors; Design; Blast furnaces; Computer simulation; Storage; Computer-aided design; Mechanical handling; Mechanical handling equipment; Operations; Performance; Mining ; Coal mining; Mining operations; Technology
Identifiers: rail-barge coal shipping; slurry pipelines; engineering; shiftable belt conveyors; overland belt conveyors ; computer aided drafting
Class Codes: D6720; D7300

042686 D7604977 Slurry Pipeline Design
ENERGY TRANSPORTATION-A CASE STUDY FOR THE ELECTRICITY SUPPLY INDUSTRY
DAWSON, K.; SARGENT, M.A.
STATE ELECTRICITY COMM. OF QUEENSLAND, BRISBANE, QUEENSLAND, AUSTRALIA
SPONSOR: INSTN. ENGRS., AUSTRALIA
THERMOFLUIDS CONFERENCE 1975 ON ENERGY' TRANSPORT, STORAGE AND CONVERSION (PREPRINTS) 91-5 1975
3-5 DEC. 1975 BRISBANE, AUSTRALIA
Publ: INSTN. ENGRS., AUSTRALIA, BRISBANE, AUSTRALIA
VII+119+12(SUPPL) pp. ISBN 0 85825 055 1
Document Type: 06
Descriptors: ELECTRIC POWER GENERATION; ELECTRIC POWER TRANSMISSION; TRANSPORTATION; DESIGN; PIPELINES; ECONOMICS; COAL
Identifiers: 2000 MW POWER STATION; QUEENSLAND; ENERGY TRANSPORTATION; ELECTRICITY SUPPLY INDUSTRY; FEASIBILITY; DESIGN; ELECTRICAL TRANSMISSION; UNIT TRAIN; ECONOMICS; REMOTE ENERGY RESOURCE; DEPOSIT OF STEAMING COAL; SLURRY PIPELINE
Class Codes: D8230; D8210

042645 D7604936 Slurry Pipeline Design
PRELIMINARY INVESTIGATION ON THE HYDRAULIC TRANSPORT OF QUEENSLAND COALS IN PIPELINES
WONG, L.S.; HACQUOIL, G.E.
GUTTERIDGE HASKINS AND DAVEY, BRISBANE, QUEENSLAND, AUSTRALIA
SPONSOR: INSTN. ENGRS., AUSTRALIA
THERMOFLUIDS CONFERENCE 1975 ON ENERGY' TRANSPORT, STORAGE AND CONVERSION (PREPRINTS) 101-6 1975
3-5 DEC. 1975 BRISBANE, AUSTRALIA
Publ: INSTN. ENGRS., AUSTRALIA, BRISBANE, AUSTRALIA
VII+119+12(SUPPL) pp. ISBN 0 85825 055 1
Treatment: P
Document Type: 06
(12 Refs)
Descriptors: PIPELINES; DESIGN; TWO-PHASE FLOW; COAL; PUMPS; OPTIMISATION; HYDRAULIC EQUIPMENT
Identifiers: DESIGN PROCEDURE; OPTIMISATION; HYDRAULIC TRANSPORT; QUEENSLAND COALS; SLURRY PIPELINES; VISCOMETER TESTS; EFFECTS OF CONCENTRATION; PARTICLE SIZE DISTRIBUTION; ECONOMIC EVALUATION
Class Codes: D6710; D5310; D5540

042644 D7604935 Slurry Pipeline Design
FACTORS AFFECTING THE HYDRAULIC PERFORMANCE OF SLURRIES. (COAL AND MINERAL TRANSPORT)
THOMAS, A.D.
SPONSOR: INSTN. ENGRS., AUSTRALIA
THERMOFLUIDS CONFERENCE 1975 ON ENERGY' TRANSPORT, STORAGE AND CONVERSION (PREPRINTS) 96-100 1975
3-5 DEC. 1975 BRISBANE, AUSTRALIA
Publ: INSTN. ENGRS., AUSTRALIA, BRISBANE, AUSTRALIA
VII+119+12(SUPPL) pp. ISBN 0 85825 055 1
Treatment: P
Document Type: 06
(11 Refs)
Descriptors: PIPELINES; PUMPS; DESIGN; TWO-PHASE FLOW; HYDRAULIC EQUIPMENT; COAL; MINERALS AND ORES
Identifiers: HYDRAULIC PERFORMANCE; SLURRIES; MINERAL TRANSPORT; SLURRY PIPELINE; MEDIAN PARTICLE SIZE; PARTICLE SIZE DISTRIBUTION; PRESSURE GRADIENT; CRITICAL DEPOSIT VELOCITY; PIPE LOOP TESTS; COAL; TWO PHASE FLOW; PIPE FLOW; SOLIDS CONCENTRATION
Class Codes: D6710; D5540; D5310

042643 D7604934 Slurry Pipeline Design
THE HYDRAULIC TRANSPORTATION AND STORAGE OF COKING COAL
BOYLE, B.E.; BOYLE, L.A.
SPONSOR: INSTN. ENGRS., AUSTRALIA
THERMOFLUIDS CONFERENCE 1975 ON ENERGY' TRANSPORT, STORAGE AND CONVERSION (PREPRINTS) 86-90 1975
3-5 DEC. 1975 BRISBANE, AUSTRALIA
Publ: INSTN. ENGRS., AUSTRALIA, BRISBANE, AUSTRALIA
VII+119+12(SUPPL) pp. ISBN 0 85825 055 1
Treatment: P
Document Type: 06
(2 Refs)
Descriptors: PIPELINES; PUMPS; TWO-PHASE FLOW; COAL; DESIGN; STORAGE; TRANSPORTATION; HYDRAULIC EQUIPMENT
Identifiers: HYDRAULIC TRANSPORTATION; STORAGE; COKING COAL; POSITIVE DISPLACEMENT ROTARY RAM SLURRY PUMP; PIPELINE TRANSPORTATION; COAL HANDLING; HYDRAULIC POWERED FREE PISTON; ROTATING CYLINDER BLOCK
Class Codes: D6710; D5540; D5310

039509 D7601800 Slurry Pipeline Design
MODIFICATIONS AND IMPROVEMENTS TO THE SLURRY PUMPING SYSTEM AT NO. 1 SHAFT VAAL REEFS SOUTH
TAYLOR, A.R.; HAUSLER, G.R.
ROBINSON, L.R.; BUNT, E.A.; KRAFT, K. (Editors)
SPONSOR: S. AFRICAN INSTN. MECH. ENGRS.
INTERNATIONAL CONFERENCE ON HOISTING MEN MATERIALS MINERALS 425-7 1974
16-24 OCT. 1973 MARSHALLTOWN, S. AFRICA
Publ: S. AFRICAN INSTN. MECH. ENGRS., MARSHALLTOWN, S. AFRICA
464 pp.
Treatment: P
Document Type: 06
Descriptors: PUMPS; HOISTS; HYDRAULIC EQUIPMENT; DESIGN; MINING EQUIPMENT; LIFTS; PIPELINES
Identifiers: PUMPING OF QUARTZITE FINES; RECIPROCATING PUMPS; HYDRAULIC SYSTEM; MODIFICATIONS; SLURRY PUMPING SYSTEM; NO. 1 SHAFT VAAL REEFS SOUTH; MITSUBISHI MARS PUMPING SYSTEM
Class Codes: D7300; D5540; D7300; D6710; D6730

SLURRY PIPELINE STANDARDS

146754 80-006563
COAL AND COAL MINE DRAINAGE,
OLEM HARVEY
TVA,
WPCF J, JUN 80, V52, N6, P1415 (15)
LITERATURE REVEIW: LITERATURE PERTAINING TO THE POTENTIAL ENVIRONMENTAL IMPACTS OF PROJECTED INCREASES IN COAL USE IN THE U.S. FROM 1975-85 IS REVIEWED. MAJOR MINING IMPACTS ARE PROJECTED FOR PRESENTLY UNREGULATED ACTIVITIES AND POLLUTANTS SUCH AS TRACE METALS AND TOTAL DISSOLVED SOLIDS. IMPACTS OF THE CLEAN WATER ACT OF 1977 ON THE MINING INDUSTRY ARE DISCUSSED. LEGAL AND REGULATORY ISSUES AFFECTING THE COAL MINING INDUSTRY ARE EXAMINED. THE RELATIONSHIP BETWEEN MINE DRAINAGE AND THE FORMATION OF POLLUTION PRODUCTS IS INVESTIGATED. MINE DRAINAGE ABATEMENT, CONTROL, AND TREATMENT METHODS ARE DESCRIBED. THE EPA INTERAGENCY COAL CLEANING R&D PROGRAM IS SUMMARIZED. POTENTIAL ENVIRONMENTAL IMPACTS OF VARIOUS COAL TRANSPORTATION AND STORAGE ALTERNATIVES, SUCH AS SLURRY PIPELINES, ARE CONSIDERED. (141 REFERENCES)
DESCRIPTORS: *COAL MINING ; *ACID MINE DRAINAGE ; *SEDIMENTATION ; *HEAVY METALS ; *LEGISLATION, ENV-FED ; *STORM RUNOFF ; *ENV IMPACT ASSESSMENT ; LEACHING ; PH HYDROGEN ION CONCENTRATN ; NUTRIENTS ; RIVERS ; WATER QUALITY STANDARDS ; *11-12 COAL MINING
REVIEW CLASSIFICATION: 19

143699 *80-003662
COAL DATA BOOK,
PRESIDENT'S COMMISSION ON COAL REPORT, FEB 80 (235)
SPECIAL REPORT: EXTENSIVE TABLES AND GRAPHS THAT ILLUSTRATE THE WORLD ENERGY SITUATION, WITH EMPHASIS ON THE U.S. COAL FUTURE, ARE PRESENTED. WHILE WORLD DEMAND FOR OIL HAS RISEN RAPIDLY DURING THE LAST 20 YEARS, COAL PRODUCTION HAS GROWN ONLY SLOWLY. WHILE U.S. RELIANCE ON COAL HAS DECLINED FROM NEARLY 50% OF ITS ENERGY SUPPLY AT THE END OF WORLD WAR II TO LESS THAN 20% TODAY, FORECASTS GENERALLY SHOW A GRADUAL INCREASE IN THE PRODUCTION OF COAL. COAL USE IS EXPECTED TO REACH 1 BILLION TONS IN 1985 AND 1.1-1.3 BILLION TONS BY 1990. FACTORS AFFECTING THE FUTURE USE OF COAL IN INDUSTRY INCLUDE: WHETHER EPA'S NEW SOURCE PERFORMANCE STANDARDS WILL REQUIRE SCRUBBERS ON SMALL BOILERS; THE LEVEL OF INVESTMENT TAX CREDITS THAT WILL BE MADE AVAILABLE FOR NEW COAL-FIRED BOILERS, PROCESS HEATERS, AND ENVIRONMENTAL CONTROL EQUIPMENT; AND NATURAL GAS AND OIL PRICES. CURRENTLY SOME 54 MILLION TONS OF COAL ARE EXPORTED FROM THE U.S. AS OF JANUARY 1, 1976, MORE THAN 437,682 MILLION TONS OF POTENTIALLY MINEABLE DEMONSTRATED COAL RESERVES HAD BEEN CATALOGUED BY USBM. ALSO DISCUSSED ARE DATA ON: COAL PRODUCTION BY REGION AND METHOD OF MINING; TYPICAL UNDERGROUND AND SURFACE MINE COSTS; PROJECTED DELIVERED COAL PRICES TO ELECTRIC UTILITIES BY 1985; NUMBER OF U.S. COAL MINES BY SIZE; COAL INDUSTRY EMPLOYMENT STATISTICS BY MINING REGION AND METHOD FROM 1969 TO 1978; THE EDUCATIONAL BACKGROUND OF THE COAL INDUSTRY LABOR FORCE; COAL MINE ACCIDENT CLASSIFICATIONS; SURFACE AND UNDERGROUND COAL MINING TE[illegible]
PIPELINES, RAIL, WATER, AND HIGHWAY; FEDERAL AND STATE REGULATION OF THE COAL INDUSTRY; AND DOE'S R&D BUDGET FOR COAL DURING FY 79. (NUMEROUS DRAWINGS, GRAPHS, MAPS, TABLES)
DESCRIPTORS: *DATA, COAL ; *REGULATIONS, ENV-FED ; *COAL DEMAND ; *COAL PRODUCTION ; *COAL RESERVES ; *PRICES, COAL ; *COAL TRANSPORT ; COAL MINING ; COAL PROCESSING ; COAL CLEANING ; AIR QUALITY STANDS ; WATER QUALITY STANDARDS ; LAND RECLAMATION ; *11-12 COAL MINING
REVIEW CLASSIFICATION: 03

137171 79-004409
THE ENVIRONMENTAL AND POLLUTION ASPECTS OF COAL SLURRY PIPELINES,
FADDICK, R. R. ; GUSEK J. J.
COLORADO SCHOOL OF MINES,
PRESENTED AT SLURRY TRANSPORT ASSN/ET AL 2ND INTL SLURRY TRANSPORTATION TECHNICAL CONF, LAS VEGAS, MAR 2-4, 77, P73 (10)
TECHNICAL REPORT: TO ENABLE THE SELECTION OF BETTER DESIGN, CONSTRUCTION, AND OPERATION TECHNIQUES FOR COAL SLURRY PIPELINES, THE ENVIRONMENTAL AND POLLUTION ASPECTS OF THESE SYSTEMS ARE EXAMINED. USE OF A COAL SLURRY PIPELINE MAY IMPACT THE ENVIRONMENT AT THREE STAGES: SLURRY PREPARATION, SLURRY TRANSPORT, AND SLURRY SEPARATION. TO PRODUCE COAL SLURRY, ABOUT ONE TON OF WATER PER TON COAL IS REQUIRED. WATER QUALITY MUST BE CONTINUOUSLY MONITORED IN ALL PHASES OF SLURRY PIPELINE OPERATION. WATER QUALITY CHARACTERISTICS MAY BE IMPROVED OR DEGRADED IN THE DEWATERING PROCESS. OPTIMAL PIPELINE ROUTES SHOULD REFLECT ENVIRONMENTAL VALUE JUDGEMENTS AS WELL AS ENGINEERING AND ECONOMIC RESTRAINTS, AND CAN BE CHOSEN WITH THE AID OF A COMPUTER. ENVIRONMENTAL PROBLEMS CREATED BY COAL SLURRY PIPELINES ARE NOT INSOLUBLE. (3 DIAGRAMS, 2 GRAPHS, 22 REFERENCES, 1 TABLE)
DESCRIPTORS: *COAL SLURRY PIPELINES ; *CONF PAPER ; *ENV CONSTRAINTS-COAL ; *WATER SUPPLY, INDUSTRIAL ; *WATER LAW ; *WATER QUALITY STANDARDS ; *PIPELINE CONSTRUCTION ; *SEPARATION PROCESSES ; *PIPELINE OPERATION ; PIPELINE MAINTENANCE ; LAND USE PLANNING
REVIEW CLASSIFICATION: 03

136931 *79-004186
EIGHTEEN MONTHS OF OPERATION WASTE DISPOSAL SYSTEM: BRUCE MANSFIELD POWER PLANT, PENNSYLVANIA POWER COMPANY,
ROTHFUSS, LARRY W. ; WORKMAN KEITH H.
DRAVO LIME CO, PITTSBURGH, .EARL H.
PRESENTED AT EPA FLUE GAS DESULFURIZATION SYM, FLORIDA, NOV 77, V2, P555 (38)
SURVEY REPORT: DESIGN AND OPERATION OF THE FLUE GAS CLEANING SLUDGE SYSTEM AT THE BRUCE MANSFIELD POWER PLANT IN SHIPPINGPORT, PA., ARE DESCRIBED. THE MANSFIELD FGC SYSTEM IS COMPOSED OF A PUMPING PLANT, A 7 MI LONG SLURRY PIPELINE, AND 1400 ACRE DISPOSAL AREA. CALCILOX, A STABILIZING AGENT, IS ADDED TO THE SLUDGE TO LIMIT ADVERSE ENVIRONMENTAL IMPACT AGENT, IS ADDED TO THE SLUDGE TO LIMIT ADVERSE ENVIRONMENTAL IMPACTS. SLURRY AND TREATMENT PROCESS DESIGN PARAMETERS ARE LISTED. DISCUSSED ARE: PROJECT DEVELOPMENT; STARTUP OF MINIMAL MANUAL SYSTEMS; WASTE QUANTITY DATA PROJECTIONS; PERSONNEL REQUIREMENTS: SYSTEM OPERATING COSTS: FULL-SCALE SYSTEM OPERATION; SLUDGE STABILIZATION: AND THE EFFECTS OF THE OPERATION ON AREA WATER QUALITY. DISCHARGES FROM THE MANSFIELD FGC OPERATION FALL WITHIN REGULATORY LIMITS FOR WATER PH, TOTAL SUSPENDED SOLIDS, DISSOLVED IRON, AND TOTAL ALUMINUM. PERIODIC MAINTENANCE IS REQUIRED TO PREVENT SLURRY LINE CLOGGING AND TO PRESERVE ACCURATE CALIBRATION. (4 DIAGRAMS, 3 GRAPHS, 3 PHOTOS, 9 TABLES)
DESCRIPTORS: *POLLUTION CONTROL SIDE EFFECTS ; *SLUDGE DISPOSAL ; *POWER PLANT EMISSION CONTROL ; *SLURRY PIPELINES ; *SLUDGE TREATMENT ; *STABILIZATION PONDS ; *RESERVOIRS ; DISPOSAL SITES ; LABOR COSTS ; CAPITAL COSTS ; WATER QUALITY STANDARDS ; OPERATING-MAINTENANCE COSTS ; PENNSYLVANIA ; EPA CONF PAPER
REVIEW CLASSIFICATION: 19

104280 75-F00082
OFFICE OF PIPELINE SAFETY, TRANSPORTATION BY PIPELINE, V40, N44, P10181
REGARDING MINIMUM FEDERAL SAFETY STANDARDS, OFFICE OF PIPELINE SAFETY ESTABLISHED WELDING REQUIREMENTS FOR TRANSPORTATION OF LIQUIDS BY PIPELINE.
DESCRIPTORS: *U S DEPT TRANSPORTATION ; *PIPELINE TRANSPORTATION ; *SLURRY ; *TRANSPORTATION SAFETY ; FED REGISTER ENTRIES
REVIEW CLASSIFICATION: 18

Print 18/5/1-21
DIALOG File16: PROMT - 72-83/A (Item 1 of 21) User 1446 9mar83

776891 Cdn Chem P 82/02/19 P29-31+
Canada: Future development of Alberta's extensive coal deposits could depend on working out fluids handling techniques, such as coal slurry pipelines. Factors which must be considered in pipeline design are the length of the pipeline, preparation of slurries, loading techniques and transporation to markets. A coal slurry tranportation system should consist of a preparation plant to crush and pulverize the coal and mix it with the liquid transport medium, a pipeline with pumping stations to maintain adequate velocity and a terminus with loading facilities. Chieftain Development, Westcoast Transmission and the Alberta govt are carrying out a feasibility study for a coal/methanol slurry pipeline from Alberta to British Columbia to to economically export Alberta coal to Japanese and other markets. The firms have budgeted $3 mil in 1982 to study the project's technical and economic aspects. Methanol is being considered as the transport medium due to its fuel value and lesser environmental impact at the terminus vs a coal/water slurry. Two basic coal slurry pipeline transport schemes have been proposed. A pilot project would involve moving 3 mil tpy of coal mixed with 1.4 mil tpy of methanol. The 2nd project would transport 18 mil tpy of coal and up to 8 mil tpy of methanol. Methanol could be made from natural gas in the pilot scheme, but coal would be preferred as a feedstock to produce larger quantities required for the 2nd project.

*2CAN *Canada *1100000 *Coal *485 *transport svcs
2CAN Canada 4619003 Coal Slurry Pipelines 395 transport tech
2CAN Canada 4619003 Coal Slurry Pipelines 395 transport tech

756005 Coal M&P 82/03 P13,17 Coal Outlk 82/03/15 P2,3
New York City Dept of Ports & Terminals may build a $300mil, 20mil tpy coal terminal on Staten Island. Quennell Rothschild Assoc and Buckhurst, Fish, Hutton, & Katz, consulting firms, have the urban design study contract. The coal export terminal, underscoring the city's seriousness in becoming a major US coal exporter, woud move coarse coal through an 8-mi slurry pipeline. The other $150 mil would be spent to derdge New York's channel to 68 ft to accommodate 260,000 dwt supercolliers. The 2 firms have conducted waterfront development studies for the Yonkers waterfront. The city wants to create public access to the waterfront on Staten Island as part of the overall coal port project. The project includes a railyard connection in northwest Staten Island, an underground slurry pipeline to carry coal across the island and a dewatering shed where the coal would be loaded aboard ships for export to Europe.

*1236 *New York *4227000 *Coal Storage *443 *new capacity
1236 New York 8911000 Engineering Services 613 new orders Buckhurst Fish Hutton
1236 New York 8911000 Engineering Services 613 new orders Quennell Rothschild

DIALOG File16: PROMT - 72-83/A (Item 3 of 21) User 1446 9mar83 2355

728117 #Concrete P 82/02 P30-32
Elastizell Corp of America (Ann Arbor, Mich) has a proprietary chemical design--Elastizell--for cellular concrete, a low-density material used to overcome unstable soil conditions, especially in Michigan, Wisconsin and Minnesota. Elastizell is added to concentrated cement/water slurry to produce concrete 1/5-1/8 the weight of ordinary concrete, for 12-25% savings on such projects as roadway fills, bridge deck approaches, sanitary landfills, filling tunnel voids or abandoned pipelines, and filling around pipelines under railroad tracks. The lowest of the 6 classes of Elastizell has an air dry density of 12-18 pcf and compressive psi strength up to 2.9 tons/pcf, and tne highest an air dry density of 45-75 pcf. Largest application has been a 40,000 yd3 bridge approach fill job.

*1USA *United States *3273000 *Ready-Mix Concrete *331 *product developmnt
*Elastizell Corp America
1USA United States 2899542 Concrete Curing Materials 337 applications

727255 Pipeline 82/02 P60
Gulf Interstate Engineering (US) will market slurry pipe line systems in the US and Canada for Salzgitter Industriebau and Pipeline Engineering (W Germany), using its $7 mil computer-controlled pilot plant in Salzgitter to determine the best design applications.

*1USA *United States *4619003 *Coal Slurry Pipelines *385 *gets license
*Gulf Interstate Engineer
1USA United States 4619003 Coal Slurry Pipelines 385 gets license Gulf Interstate Engineer
4WGE West Germany 4619003 Coal Slurry Pipelines 383 license sold Salzgitter Industriebau
4WGE West Germany 4619003 Coal Slurry Pipelines 383 license sold Salzgitter Industriebau
9JPN Japan 4619003 Coal Slurry Pipelines 383 license sold Pipeline Engineering
9JPN Japan 4619003 Coal Slurry Pipelines 383 license sold Pipeline Engineering

723351 Am Mtl Mkt 82/02/04 P6
Sidermex has given a $26mil contract to Dravo (Pittsburgh, Pa) for a 3mil tpy iron ore pelletizing plant at the direct reduced iron project in Lazaro Cardenas, Mexico; completion: 1983. Dravo said the contract is for design, engineering and procurement and construction management liaison. The plant, which will include slurry receiving, filtering, balling and other equipment, will be fed through a slurry pipeline from a concentrator to be built at a mine site 17 mi away.

*3MEX *Mexico *3310000 *Primary Iron & Steel *443 *new capacity *Sidermex

DIALOG File16: PROMT - 72-83/A (Item 6 of 21) User 1446 9mar83 2356

698912 Chem Week 81/12/02 P14,15
The $3.25bil H-Coal pilot plant in Breckenridge County, Ky, has had problems that will increase the cost of the commercial-scale plant at Catlettsburg, Ky, to be run by Ashland Synthetic Fuels. Construction costs of the commercial plant will be about $2 bil, divided among the liquefaction unit (35%), hydrogen and oxygen plants (15%), wastewater and solids treating plant (10%), and pollution control for the boilers (15%). Operating expenses will average $18/bbl after $5 bbl credits for sulfur, ammonia, phenol and pipeline gas byproducts. High-pressure charge pumps, reactor preheating furnace and slurry letdown valves all are hardware which may be vulnerable to failure. The average run time at the pilot plant between maintenance outages is 10 d. Poor construction supervision at the pilot plant has led to damage of at least $100,000 worth of equipment. DOE has also been criticized by GAO for signing contracts too early, making costly design changes necessary. A large number of subcontracts added considerably to the final cost of the pilot plant.

*1USA *United States *1311120 *Crude Petroleum from Coal *443 *new capacity *Ashland Synthetic Fuels

695766 #Metl Bul M 81/10 P121-124
Australasia: Has significant reserves of vanadium, most of which are not yet commercially viable, according to LW Walsh of Agnew Clough (Australia), the region's only vanadium producer through its Coates Vanadium div at Wundowie, W Australia where design output is 1,620 tpy of V205 from the lateritic surface zone. Long term reserves are in the underlying fresh rock or primary ore. Agnew Clough also controls the Balla occurrence (W Australia), another magnetite-rich portion of a large gabbro intrusion. A drilling programme to 180 m depth has estimated ore reserves at 150 mil tons. Agnew Clough also holds the Gabanintha titaniferous magnetite deposit, similar in grade and mineralogy to the very large Barrambie deposit which Ferrovanadium Corp NL may develop. Deposits are estimated at 15% TiO2, 0.7% V205 and 26% Fe, which can be concentrated to 26%, 1.25% and 46%, respectively. The company is studying plans to produce 500,000 tons of concentrate at the mine site to be transported by slurry pipeline to Geraldton for electric smelting. Target production could be 216,000 l tons of steel, 185,000 l tons of 70% TiO2 slag and 5,400 l tons of V205 flake. There are other deposits in the Jameson Range, W Australia, in the Julia Creek oil shale deposit in Queensland, and at Glenbrook, North Island, New Zealand, where New Zealand Steel uses a titanomagnetic ironsand for a prereduction/electric smelting process for steel. The Yeelirrie Joint Venture will start commercial output of uranium in 1986, with by-product vanadium output estimated at 700 tpy V2P5 equivalent.

*9AUN *Australia & New Zealand *3339787 *Vanadium *412 *mineral reserves

DIALOG File16: PROMT - 72-83/A (Item 8 of 21) User 1446 9mar83 2357

663780 Phosphorus 81/04 P14

Fertilizantes Vale de Rio Grande's (Brazil) phosphate fertilizer complex at Uberaba, Minas Gerais, is complete and fully operational. Superphosphate and monoammonium phosphate plants at the complex have the capacity to produce 165,000 m tpy of P205. Other facilities include a 330,000 m tpy phosphoric acid plant and a 858,000 m tpy sulfuric acid plant. Financing was provided by the World Bank ($82 mil) and a joint World Bank venture with a private US bank for $20 mil in loans. Gulf Design and Natron Consultoria e Projectos oversaw design and construction. The 102,000 m tpy Valep mine provides phosphate rock and the ore is transported via pipeline in the form of slurry.

*3BRA *Brazil *2874000 *Phosphate & Other Fertilizers *443 *new capacity
*Fertilizantes Vale Rio

654131 #O&G Jour 81/06/15 P79-83

A detailed projection of pipeline construction, energy demand and practical advances in pipeline design, construction and operation is provided. US oil production in 2000 may reach 8.7 mil bpd. Gas pipeline activity will be highlighted by new pipelines from the Alaskan and Canadian Arctic, and new gas pipelines from the Mountain region will be built to serve synthetic gas conversion plants and new natural gas discoveries. Crude oil pipeline activity will decline as the consumption of oil in the US stabilizes. Products pipeline activity will also decrease as the consumption of petroleum products stabilizes. Coal-slurry pipeline construction will make up 25% of the interregional pipeline construction. These pipelines will serve US electric generation plants and the export market for coal. Pipelines carrying CO2 from underground reservoirs and from synthetic fuel plants to old oil fields for enhanced recovery purposes will add to the total pipeline picture.

*2CAN *Canada *4923100 *Gas Transmission *600 *market data
1USA United States 1311000 Crude Petroleum 622 production
2CAN Canada 4923100 Gas Transmission 600 market data

DIALOG File16: PROMT - 72-83/A (Item 10 of 21) User 1446 9mar83 2358

632472 #Hydrocarbn 81/02 P111-117

Tosco Corp's Toscoal process has been proved feasible to produce synfuels and char for power generation. Integration of the Toscoal process into the coal-fired electric utility industry could result in a substantial contribution to domestic oil supplies. Lab combustion tests indicate that pyrolysis char burns in a conventional coal boiler with similar efficiency and burnout time as raw coal; however, tonnage quantities of char must be tested in a pilot combustion chamber and major boiler manufacturers have to test equipment and establish necessary design criteria for existing and new boilers. Heavy coal liquids from pyrolysis and direct liquefaction plants have been successfully tested by hydrotreating process licensors; however, additional information is needed on liquids from specific coals to design hydrotreating facilities and establish refinery feedstock values. Commercially proven technology is unavailable for passivating chars from western coals. Transportation cost savings appear to be large enough to justify more development work. The Toscoal process is a low-temperature coal pyrolysis process based on the Tosco II process for oil shale retorting. Potential benefits for the process include reduced coal transportation costs by rail or slurry pipeline, reduced sulfur emissions from coal-fired power plants and char production may be attractive for gasification by entrained flow or fluid bed processes and for manufacture of formed coke from nonmetallurgical-grade coals. Article examines process, design basis and coal types.

*1USA *United States *1311100 *Synthetic Crude Petroleum *323 *new process *Tosco

DIALOG File16: PROMT - 72-83/A (Item 11 of 21) User 1446 9mar83 2359

495712 #Newsweek 79/07/16 P23-33

At present rates of consumption, the US will use up its crude oil supply in 8.7 yrs, its natural gas supply in 10.7 yrs and its coal supply in 666.5 yrs, according to DOE. Continuing along this line, the US will import 12 mil bpd of oil by 1985, a 50% rise over current levels; the bill will reach $10 mil/hr at existing prices. The US energy bill has risen from $1.3 bil to $60 bil in less than 10 yrs. Newsweek presents ideas on what should be done to insure the US energy future, including decontrol of natural and refined gas prices and the abolishment of the govt allocation system. Free markets can allocate resources more efficiently than govt bureaucracies do, according to Newsweek, so decontrol of oil and gasoline prices is necessary. Decontrolling prices would add 1 mil bpd of oil to supplies by 1985, according to the Admin. Decontrol of gasoline could add 20 cents to the price of gasoline at the pump. Limits on imports of oil should be imposed and strengthened in 1980. After 1980, the ceiling on imports should be lowered from the 1979 level by 250,000 bpd until 1986, when it would be set at 7 mil bpd. Export restrictions on Alaskan crude should be lifted. Efforts to promote exploration and development should be made through the World Bank and other international agencies. Conservation could result in savings of several million bpd of oil by 1990 with little or no loss of economic growth. Slurry pipelines would be the cheapest way of transporting coal. A govt corporation to develop synthetic fuels would spend $46 bil by 1995 to build plants to produce 2 mil bpd of synthetic fuel. Only $6 bil would come from the govt, the rest coming from bonds and loan guarantees. Private industry should be encouraged to invest up to $75 bil in synthetic fuels by 1990. Plants producing 50,000 bpd of synthetic fuels would require 30,000 tpd of coal to operate. Estimates are that it would take 2 yrs to design a coal liquefication plant and 4 more yrs to build it, costing $1-3 bil before the first barrel of synthetic fuel is produced. Transportation uses 10 mil bpd of oil, 55% of daily US use. Mass transit will hto be improved. The less-travelled, longer Amtrak routes should be cut and the money used for shorter heavily-used lines.

*1USA *United States *2900100 *Energy *932 *energy regulatn
1USA United States 9106500 Energy Programs 932 energy regulatn

432519 #O&G Jour 78/07/31 P104-106

The USSR is studying pipelines to carry coal slurry, ores, chemicals, sand, gravel and grain, as well as technology offering reduced construction costs, higher throughput without enlarging pipe diameter, lower operating expense and increased reliability of lines from W Siberia's oil and gas fields. The current boom in conventional gas-pipeline construction should continue through the 1980s at least. New production in the huge Urengoiskoye gas field alone is expected to require one new long-distance 56-in pipeline/yr to 1987. Production at Urengoiskoye reached 580 bil ft3/yr in June 1978 and is expected to go to 10.6 tcf/yr. Gas output in Tyumen Province could reach 35.3 tcf/yr by 2000. More petroleum product lines are also needed. The USSR currently has 170,000 km of oil and gas trunk lines in operation. Article reviews individual projects, and innovativations in pipe design and operating temperatures and pressures, including plans to protect permafrost along Arctic routes.

*6USS *USSR *4600000 *Pipelines ex Gas *436 *constructn expend
6USS USSR 4923100 Gas Transmission 436 constructn expend
6USS USSR 4923100 Gas Transmission 436 constructn expend

DIALOG File16: PROMT - 72-83/A (Item 13 of 21) User 1446 9mar83 2360

426185 Hydrocarbn 78/05 P21
A review of the latest developments in the solid fuels field lists Atlantic Richfield as the 5th sponsor of the $240 mil project to develop Exxon's Donor Solvent coal liquefaction process; a 125,000 bpd oil sands mining project in Alberta's Athabasca area would be developed by a proposed 4-firm consortium; Colorado Rio Blanco is preparing a 976-ft vertical mine shaft for its oil shale project; a new lignite upgrading process developed by SRI Intl is said to make low-sulfur Western coal equivalent in heating value to Eastern bituminous. A new conceptual design of a $3.1 bil facility for converting 74,000 tons of coal to 415,000 bpd of methanol has been prepared for DOE by Badger Plants; fuel costing $3/mil Btu would be produced from coal costing $1/mil Btu. Energy Transportation Systems will extend its Wyoming-Arkansas coal slurry pipeline to Baton Rouge, La.

*1USA *United States *2900100 *Energy *443 *new capacity

392279 Metal Bul 77/08/26 P36
Samarco Mineracao SA's iron mine project will be inaugurated in late 1977 including the world's largest slurry pipeline at 400 km. Filter cake production began in June 1977 and pellet production was scheduled in Aug 1977. Initial production of the plant at Ponta Ubu, Brazil, is 5 mil m tpy of pellets and 2 mil m tpy of filter cake. Iron ore comes via the 20-in dia pipeline from the Germano mine near Belo Horizonte, as a 67% Fe slurry concentrate. The Ponta Ubu shipping berth can load at 8,000 tph. Samarco Mineracao is a joint venture of SA Mineracao de Trindade and Utah International. Engineering, procurement and project management services performed in the US are being handled for Samarco by Consorcio Ponta Ubu, a joint venture of International Engineering Co (a Morrison-Knudsen firm) and Dravo Corp. Morrison-Knudsen Internacional de Engenharia in Rio is providing construction management and procurement in Brazil, and Cia Internacional de Engenharia (49% owned MKIE affiliate) is performing detail design.

*3BRA *Brazil *4619009 *Pipelines ex Gas NEC *436 *constructn expend
*Samarco Mineracao

DIALOG File16: PROMT - 72-83/A (Item 15 of 21) User 1446 9mar83 2361

381460 Energy 77/06/06 P11
ERDA is committing $24 mil to design and implement conversion of existing oil-burning industrial boilers and blast furnaces to coal-oil slurry, an emulsion of powdered coal and oil, to demonstrate that coal-oil slurry is a cost-competitive technology compared to other energy sources. ERDA's fossil energy admin hopes the program will result in widespread commercial use of the technology by industry and utilities by 1979. While coal slurry has successfully passed the experimental R&D phases, major stumbling blocks have stood in the path of commercialization. The expenses of boiler conversion and of meeting environmental standards have been prohibitive. Interlake Iron Corp (Chicago, Ill) is now negotiating details of a $1-2 mil contract with ERDA to convert a 60,000 lb/hr oil burning boiler to coal-oil slurry. The boiler is part of a drying system in a tobacco drying and stemming plant owned and operated by the Lorillard Div of Lowes Inc. Also utilities Northeast Power (Salem, Mass) and City Public Service (Corpus Christi, Tex) will receive $5-10 mil each to convert their respective 80-MW oil-fired and 60-MW gas-fired boilers to coal-oil slurry.

*1USA *United States *4619003 *Coal Slurry Pipelines *436 *constructn expend
1USA United States 1623140 Pipeline Construction 611 seeks contract City Public Service
1USA United States 1623140 Pipeline Construction 611 seeks contract Northeast Power
1USA United States 1623140 Pipeline Construction 613 new orders Interlake Iron

325634 Hydrocarbn 74/06 P15
One of the more controversial new developments in the pipe line industry is an assertion that the US plan to achieve energy independence by 1980 can be met, and a brake put on rapidly increasing energy costs, by use of coal slurry pipe lines. So says a multiclient study, called 'A Coal Slurry Pipeline from the Western Coal Reserves of the US,' prepared by Planning & Forecasting Consultants (Houston, Tex). The report visualizes a major new industry developing to transport coal via pipe line, noting: this is a logical approach since such a pipe line system can utilize large proven reserves of coal and established markets. Shell Development Co (SDC) has outlined a research program for laying offshore pipe lines in water depths to 3,000 ft with consideration, where feasible, of depths to 6,000 ft. Pipe diameters up to 30 inches will be considered. The program is primarily limited to design analyses. The study will include consideration of pipe stability and integrity on bottom, pipe materials and wall thickness, pipe coating and jacket materials, pipe welding techniques, and pipe line construction methods. SDC seeks $750,000 in funding from companies willing to co-op the research.

*1USA *United States *4600000 *Pipelines ex Gas *337 *Applications
1USA United States 1000010 Offshore Mining 313 Basic R&D Shell Development
1USA United States 1000010 Offshore Mining 313 Basic R&D Shell Development
1USA United States 2900190 Energy via Misc Sources 691 Matrl Dist

DIALOG File16: PROMT - 72-83/A (Item 17 of 21) User 1446 9mar83 2362

172125 #Chem Eng 77/04/25 P95-100
Pipeline design for industrial slurries--Article gives a rundown on the techniques for predicting transport velocities, pressure gradients and other parameters needed for slurry pipeline design.

*4UK *United Kingdom *4619000 *Pipelines NEC *319 *research nec

172124 #Chem Eng 77/04/25 P107-110
Instrumentation for slurry systems--Each of the three slurry systems--nuclear, photolectric and ultrasonic--excels in certain applications, and the system designer should have all three, with their relative strengths and weaknesses, in mind when setting up job specifications. Design of slurry handling requirements should include: type of measurement (level, density); degree of accuracy required; type of solids; range of %SS to be measured; and operating conditions (aeration, temperature, ease of access to controls for recalibration, etc).

*1USA *United States *4619000 *Pipelines NEC *319 *research nec

163415 Envirn Sci 76/11/ P1086+
The Black Mesa Pipeline transports coal from the Peabody Coal Black Mesa Mine near Kayenta, Ariz, to the 1500-MW Southern California Edison Mohave Power Station, near the southern tip of Nevada. Currently the only coal slurry pipeline operating in the US is performing smoothly thus far. Black Mesa Pipeline is 278 mi long, and crosses the rugged terrain. Also, it must provide smooth operation, high availability, and steady coal delivery, with minimal environmental disruption or pollution in the fragile desert area through which it runs. The pipeline, when it was planned, was to be the longest of its kind in the world and still is. The pipeline was organized as an operating entity in 1966, as a wholly owned subsidary of Southern Pacific Pipelines, in turn 100% owned by Southern Pacific Co. By Jan 1967, the pipeline was deemed to be a 'can-do' situation, and a 35 yr contract was signed with Peabody Coal Co, to design and operate it. The system cost $39 mil to build, and has been in operation since Aug 1970. Buried at least 3 ft deep, and protected against volcanic rocks surrounding it, the line took less than 3 years to build.

*1USA *United States *4619003 *Coal Slurry Pipelines *443 *new capacity
1USA United States 8911000 Engineering Services 614 contracts data Peabody Coal

DIALOG File16: PROMT - 72-83/A (Item 20 of 21) User 1446 9mar83 2363

147495 Comp Air 75/11 P10-12

An Indonesian jungle pipeline handling slurry is an engineering marvel, moving mountian copper 69 miles to the sea. The $162 mil Ersberg copper project in the Indonesian Province of Irian Jaya (formerly West Irian) is being developed by Freeport Indoensia Inc, a subsidiary of Freeport Minerals Co. While not the largest coppper mining and processing project in the world, it has been as great a technical challenge as any. Wild, mountainous terain with humid, tropical climate made project construction an unusual technical challenge for Bechtel-Pomeroy, pipeline contractor. The pipeline moves on a basis of more than 720 tpd of ore concentrate, in slurry form, from the millsite high in the mountains of the tropical interior to port areas on the coast of Indonesia's Arafura Sea. It handles 250,000 m tpy at a moderately low unit cost, opening the 33 mil ton Ertsberg deposit to international markets. Over-the-road haulage would have been prohibitively costly. Many of the plaudits for the pipeline's success must go to the pumps, for abrasive slurries are recognized as the most difficult substances to pump successfully over long periods of time. The hard particles can cause damaging wear and pitting of key pump parts unless special design features are incorporated to minimize abrasion.

*9INO *Indonesia *4619009 *Pipelines ex Gas NEC *443 *New Capacity *Freeport Indonesia
1USA United States 1000000 Mining & Extractive Industries 140 subsidiary data Freeport Minerals
9INO Indonesia 1021000 Copper Mines 130 parent data Freeport Indonesia
9INO Indonesia 1623140 Pipeline Constructn 613 new orders Bechtel-Pomeroy

136747 Am Mtl Mkt 75/06/12 P9

Cities Service Co's new Pinto Valley copper mining complex near Miami, Ariz, is in continuous operation and is expected to produce 62,500 tpy of copper plus some molybdenum. The complex has completed its start up phase and has the ability to exceed design throughput of 40,000 tpd of ore. Cost of constructing the processing facilities was about $100 mil. Mining of the large, low grade Pinto Valley ore body is by the conventional open pit method. Copper is recovered as a concentrate and its metallic form extracted at the nearby smelting facilities of Inspiration Consolidated Copper Co. Cities Service constructed a nearly 11-mile long pipeline to pump the concentrates in slurry form to a filter plant near the Inspiration smelter for drying.

*1USA *United States *1021000 *Copper Mines *449 *Facilities NEC *Cities Service

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14. Handbook of Concrete Culvert Pipe Hydraulics. Portland Cement Association, Skokie, Ill., 1964.

15. Design and Construction of Sanitary and Storm Sewers. Water Pollution Control Federation, Washington, D.C., 1970.

16. Recommended Practice for Design, Construction, Operation and Maintenance of Offshore Hydrocarbon Pipelines. American Petroleum Institute, Washington, D.C., 1976.

17. Recommended Practice for Liquid Petroleum Pipelines Crossing Railroads and Highways. American Petroleum Institute, Washington, D.C., 1981.

18. Standard for Welding Pipelines and Related Facilities. American Petroleum Institute, Washington, D.C., 1980.

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20. Pipeline Design for Hydrocarbon Gases and Liquids. Report of the Task Committee on Engineering Practice in the Design of Pipelines, Pipeline Division, American Society of Civil Engineers, New York, 1975.

21. Govier, G.W., and Aziz, K., The Flow of Complex Mixtures in Pipes. Van Nostrand Reinhold Company, New York, 1972.

APPENDIX D Suggested Syllabus for Slurry Pipeline Manual.

1. INTRODUCTION

Relative length	Short.
Goal	To inform the reader in simple language what the manual is all about.
Objectives	To show the role of slurry pipelines in the future Canadian transportation network. To indicate the economic advantage of slurry pipelines. To give the origin and general purpose of the manual. To explain the organization of the manual. To outline the goals of the manual. - to provide a practical design manual; - to transfer R & D results into a practical technological source document; - to focus attention on specific design difficulties and state of the art solutions; - to identify specific design problems yet to be solved and the approach to resolving them.
Scope	To give an overview of the manual. To identify the readers to whom the manual is addressed and the benefit of it to each category of reader. To show the potential of slurry pipelines in Canada.

2. HISTORICAL DEVELOPMENT OF SLURRY PIPELINES

Relative length	Short to medium.
Goal	To install confidence in planners and executives that slurry pipelines can deliver the goods.
Objectives	To show slurry pipelines have been used successfully in the past.
	To show that slurry pipelines have become bigger, longer, and better with time.
	To show that slurry pipelines have economic advantages over other methods of transportation.
	To show the potential future development for slurry pipelines.
Scope	To outline landmark slurry pipelines on a global, North American, and Canadian basis.
	To make a general analysis of trends in type of commodities, throughout, length of line, equipment development, competitiveness with alternate transport methods, inflation, minimal environmental effects, etc.
	To discuss the possibilities of using multi-commodity batching, additives for pressure gradient reduction and higher solids concentrations, alternative fluids for multiple markets and in-line processing.

3. CONVENTIONAL LIQUID PIPELINE DESIGN

Relative length	Medium.
Goal	To present a familar background on which to develop slurry pipeline design.
Objectives	To outline the principles of liquid flow through pipelines. To review the steps in designing an oil pipeline.
Scope	To review the properties and characteristics of liquids, i.e. fluidity, visosity, density, temperature effects in general terms. To review the mechanics of liquid flow in pipelines, i.e. static head, dynamic head, friction losses, laminar and turbulent flow in general terms. To describe the steps in designing an oil pipeline: - liquid properties that must be determined; - pressure gradient formulae which could be used; - route profile; - selection of pipe diameters; - pump station locations; - pump selection; - pipe specifications; - future capacity expansion alternatives. To use an Appendix to provide sufficient technical background re: - rheological models; - laminar and turbulent flow; - pressure gradient equations; - energy requirements. To use reference listing to provide good coverage of current technology and practice.

4. SLURRY PIPELINE SYSTEMS

Relative length	Medium.
Goal	To provide an overview of slurry pipeline systems.
Objectives	To outline the concept of a slurry pipeline system. To show the range of systems developed to date. To describe the components of a system. To identify the design considerations unique to slurry pipelines.
Scope	Use samples from Chapter 2 to show the range and flexibility of slurry pipelines re: - commodities; - throughputs; - distances; - functions (mining, hoisting, excavating, long distance transport etc.). Use schematic layouts. Describe the components of various systems from preparation of solids to end use of solids. Describe slurry - unique design considerations such as - slurry preparation and handling; - slurry pumps; - slurry characteristics; - slurry pipeline hydraulic characteristics; - slurry dewatering; - environmental aspects.

5. SLURRY PREPARATION

Relative length	Short.
Goals	To identify the requirements of slurry preparation.
	To present ways of meeting these requirements.
Objectives	To describe the effects of PSD, solids concentration, pH, oxygen or air content, and extent of upgrading of solids on the pipeline system.
	To present ways of controlling these variables.
Scope	To discuss the effects of the variables on pumps, deposit velocity, energy requirements, corrosion, erosion, solids dewatering and end use.
	To present methods of varying and controlling the variables, through equipment selection, operating techniques, instrumentation, etc.
	To give references to the latest guides manuals, standards, and suppliers of size reduction equipment, tankage, and agitators.

6. SLURRY PUMPS

Relative length	Short.
Goal	To show how to select slurry pipeline pumps.

Objectives	To describe the types of pumps suitable.
	To discuss the performance and maintenance of these pumps.
	To present criteria for pump selection.
Scope	To describe the general characteristics of centritugal and positive displacement pumps when pumping slurries.
	To outline the advantages and disadvantages of these pumps, i.e., size of particle handled, efficiency, discharge pressure, valving, maintenance, etc.
	To indicate the areas of application of each kind of pump.
	To give references to the latest guides, manuals, standards, and suppliers of pumps.

7. SLURRY FLOW CHARACTERISTICS

Relative length	Medium.
Goal	To outline the principles of slurry flow through pipelines.
Objectives	To characterize suspensions.
	To indicate the difference between liquids and slurries.
	To describe homogeneous slurry flow in pipelines.
	To describe heterogeneous slurry flow in pipelines.

Scope	To enumerate and discuss generally the physical and chemical properties of slurries, i.e. ρ, particle shape, d, etc.
	To enumerate and discuss generally the characterizing parameters of slurry flow, i.e., w_i, C_D, μ_m, Re_p, C_v, V_c etc.
	To use Appendices to present detailed summaries of these properties and parameters (with typical values).
	To describe homogeneous and heteorogeneous slurry flow.
	To enumerate and discuss generally design equations for homogeneous and heteoro-geneous flow of slurries.
	To explain these design equations and their limitations in detail in Appendices.

8. SLURRY PIPELINE DESIGN

Relative length	Long
Goal	To present a practical approach to de-signing slurry pipelines.
Objectives	To identify the design steps required for a slurry pipeline.
	To present at least three case studies in detail (short line for coarse solids, long line for fine solids, long line with non aqueous carrier).

Scope	To show how the following design decisions are determined: - slurry velocity; - slurry concentration; - PSD; - maximum line pressure; - pipewall thickness; - power requirements; - pump station spacing. To describe the following areas: - route selection and layout; - corrosion and erosion protection; - instrumentation and control. To present three case studies in detail. To give references to the latest applicable guides, standards, and manuals.

9. SLURRY DEWATERING

Relative length	Short.
Goals	To identify the requirements of slurry dewatering. To present ways of meeting these requirements.
Objectives	To identify the end users of pipelined slurries. To discuss the needs to dewater the slurries for these end users. To present ways of meeting the requirements of the end users.

Scope	To enumerate existing and potential end users of pipelined slurries, and their requirements.
	To present methods of dewatering slurries, listing equipment and discussing advantage and disadvantages.
	To give references to the latest guides, manuals, standards and suppliers of dewatering equipment.

10. VALUE OF PIPELINE PILOT PLANT TESTS

Relative length	Short.
Goal	To show the wisdom of a limited amount of pilot plant testing.
Objectives	To indicate the design factors which should be verified or modified through tests, i.e., PSD, attrition, pump efficiencies etc.
	To show the risks of not checking these factors.
Scope	To identify and discuss the design factors which cannot be either treated adequately theoretically or are likely to deviate from experimentally determined correlations.
	To show the potential economic consequences of overdesigning, under-designing, and system failure.

11. ENGINEERING STANDARDS

Relative length	Short.
Goal	To ensure standards are met and performance of slurry pipelines will be satisfactory.
Objective	To identify standards and specifications relevant to slurry pipelines.
Scope	To enumerate existing standards, codes and specifications relevant to slurry pipelines, i.e., steel pipe standards, valve standards, pump standards, pressure vessel code etc.
	To relate these standards etc to safety and performance of the components of slurry pipeline systems.
	To give reference to the latest standards, codes and specifications.

12. CONSTRUCTION PRACTICES

Relative length	Medium.
Goal	To present a practical approach to construction of slurry pipeline systems.
Objectives	To identify the construction practices involved in slurry pipelines, i.e. right of way acquisition through to final testing.
	To provide the details of these practices.
Scope	To review pipeline construction practices in general, as they apply to slurry pipelines, i.e. for oil pipelines as examples.

	To give detailed references to the latest publications on these practices.
	To identify and discuss modifications required for use with slurry pipelines, i.e., re slopes, testing, unblocking, dumping, etc.
	To provide guidelines for making decisions on each practice.

13. ENVIRONMENTAL ASPECTS

Relative length	Short.
Goal	To ensure adequate consideration is given to minimizing environmental effects of slurry pipelines.
Objectives	To identify potential environmental implications of slurry pipelines.
	To identify and assess technologies and practices which will minimize environmental effects of slurry pipelines.
Scope	To review the construction of slurry pipelines, as related to environmental effects, i.e., ditching, slurry dumping, dewatering, non aqueous carrier fluids, etc.
	To discuss the techniques for mitigating the effects of slurry pipelines.
	To give guidelines for minimizing environmental effects.

14. LOGISTICS

Relative length	Short.
Goal	To ensure the supplying and scheduling of adequate resources to design, construct, and operate a slurry pipeline system.
Objectives	To identify the steps from concept to successful operation of a slurry pipeline. To show the relationship and sequence of the steps.
Scope	To use the three case studies in Chapter 8 to discuss in a general manner the relationship and sequence of the steps involved. To prepare tables for the three cases to show the various items to be considered, their sequence and inter-dependence/i.e., from design concepts --- through land acquisition --- to routine operation.

15. COST ESTIMATION

Relative length	Medium.
Goal	To provide examples of slurry pipeline costs.
Objectives	To identify the major cost items in a slurry pipeline system.

	To relate these items to throughput, interest rates and inflation.
Scope	To use the three case studies of Chapter 8 to calculate the capital and operating costs of each component of the slurry pipeline systems.
	To show the effects of throughput, interest rate, system life, and inflation on these costs.

16. REGULATORY ASPECTS

Relative length	Short.
Goal	To ensure government regulations are understood and complied with.
Objectives	To identify regulations which pertain to slurry pipelines.
	To show how these regulations affect slurry pipelines.
Scope	To review applicable regulations, show how they can be accommodated, and demonstrate their influence on such matters as location of pipelines, specifications, operating costs, etc.

17. RESEARCH AND DEVELOPMENT

Relative length	Short.
Goal	To priorize future R & D

Objectives	To identify R & D needed.
	To identify current world R & D emphasis.
	To priorize R & D needed.
Scope	To review the design, construction, and operating phases of slurry pipelines, indicating the areas of uncertainty and the subjects requiring study.
	To summarize current world R & D by centre and indicate the emphasis at each centre.
	To establish priorities for future Canadian R & D for slurry pipelines.

APPENDIX E Author's Guidelines

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1. INTRODUCTION

The following guide has been prepared to assist the contributing authors of the slurry pipeline manual to develop their narrative and graphic materials in a consistent style and format.

Because of the time constraints imposed, each author will be expected to submit final, reproducible copy of his assigned chapter(s). Consequently, the authors are urged to prepare their materials in conformance with the instructions herein to avoid any unnecessary rework in the production cycle.

The guidelines essentially address the mechanics of style and format involved in preparing the copy for publication. It is recognized that the subject matter and author's judgement will dictate the amount of descriptive narrative and graphic illustrations necessary to cover the significant topic elements. However, several basic editorial standards that should be followed in writing the narrative to obtain an acceptable level of consistency throughout are included in Section 2.

The instructions provided in Section 3 and related exhibits are intended to be used as a guide in preparing the reproducible manuscript. Each author must be thoroughly familiar with the prescribed format to aid him in developing his draft, and in instructing the typists and illustrators in preparing the reproducible copy.

2. STRUCTURAL ARRANGEMENT

It is encumbent upon each responsible author to submit as complete and accurate a manuscript as possible since the time constraints for the initial distribution will not permit editing or revision after all copy has been received. The following guidelines discuss the structural arrangement of the narrative content and the editorial policy established for this manual. Each chapter should follow the basic structure described below.

PRESENTATION OF MATERIAL

The text material of each chapter should be structured as a "narrative" outline. That is, the syllabus-type outline will serve as the framework, but the major topic heads should be expanded to descriptive paragraphs. These paragraphs should be brief and should address a single topic subject.

Subtopics may also require descriptive paragraphs, depending on the subject matter being covered. In most cases, second-level topics should be described in narrative or should, as a minimum, contain a lead-in sentence to introduce a series of third-level headings. Annotated examples of this technique are given in Exhibit 1.

CHAPTER CONTENT

Each chapter should begin with a summary statement of the purpose and scope of the material to be covered. For example:

> A. Purpose and Scope. The purpose of transit demand surveys is to collect and analyze data pertaining to present and future transit needs. These studies form an essential part of the transit planning process (See Chapter 14). Transit demand surveys generally include the following elements:
>
> 1. Origin-Destination. These data are collected to determine. . . . . .

The body content should follow a logical sequence. However, since an outline structure is used, transitory sentences from one major topic to the next are not generally required. In structuring the topic sequence, it is usually desirable to progress from the general to the specific--from broad concepts to particular applications.

Graphic illustrations, tables, and brief descriptive examples should be used where such techniques will serve to clarify and/or eliminate the need for long narrative descriptions. Wherever possible references should be cited rather than quoted verbatim. In some cases, findings or study results may be paraphrased in a summary statement followed by the reference. (For example: The difference between night and day speeds is approximately 10 mph (Ref. 2).)

A reference list should be included at the end of each chapter. In this listing, do not include any references not cited in the body of the text. References should be numbered sequentially as they are mentioned in the text using the abbreviation "Ref." Chapter numbers will not be used in numbering references. (Ref. 1, not Ref. 12-1). The proper form for listing references is given in Exhibit 2.

If there are supplemental reference sources relevant to the topic that cannot be conveniently cited as a numbered reference, a bibliography of additional reading can be included after the reference list. Bibliographic listings are alphabetical and follow the format shown in Exhibit 2.

EDITORIAL POLICIES

There are a number of inherent problems in developing a manual with multiple authors writing independently. These problems are compounded when there is little opportunity to review, edit, and revise the draft manuscripts. Different writing styles cannot be avoided. There are, however, several editorial policies that can be applied in the writing process that will lend a sense of continuity to the text. The following guidelines do not attempt to cover standard rules of grammar which are readily available in numerous textbooks. Prescribed usage is indicated where choices exist. Adherence to these general policies should present little difficulty to the authors, will ultimately save considerable time and effort, and will result in a better end product.

Use of Personal Pronouns

Pronouns, such as "we", "you", and "one", should not be used. Instead of ". . . one (we, you) can see that . . ." use, ". . . it can be seen that . . ." Referring to the author or reader should also be avoided. For example, ". . . the reader may question the validity of . . ." or ". . . the author has found that . . .", the preferred usage is ". . . while there may be some question of validity . . ." and ". . . experience indicates that . . ."

Use of Numerals in Text

The accepted form of using numerals in narrative text is to spell out the numbers one to ten unless such numbers are followed by a unit of measure. ("Of the five elements involved . . ." and

". . . at -5° F.") Numbers 11 and higher are written as numerals except at the beginning of a sentence where they are spelled out ("There are 12 elements involved . . .") In cases where a range is given with one number over ten, both numbers are written numerically. ("From 5 to 15 patrons may be accommodated. . .")

Units of Measure

All units of measure in the text, tables, or graphic illustrations will be expressed in SI (metric system) units with the equivalent English system unit given in parentheses. For example: "At a distance of 5 km (3 mi), it is apparent. . ."

Headings

Headings should be brief and should not contain articles (a, the, an). To the extent possible, the form used should be consistent. ("Developing Data Base" and "Analyzing Survey Results" or "Develop Data Base" and "Analyze Survey Results").

Never use a single subheading. That is, under main topic A, there must be at least two or more numbered subheads. Where only one subhead is indicated, the information should be incorporated in the main topic paragraph(s).

Headings should stand alone and not be used as part of the introductory sentence. The opening sentence should be complete with subject and predicate independent of the heading, as shown in the following example.

A. Purpose and Scope. This chapter describes the use of transit demand surveys and includes. . .

NOT

A. Purpose and Scope of this chapter are to define the use of transit demand surveys.

Use of Abbreviations

Abbreviations in the narrative should be used sparingly and in accordance with accepted grammatical practice. For example, spell out "percent" and "degrees" (angular--use the degree symbol ^{o} for temperature). The following exceptions and forms should be noted.

It is not necessary to spell out dollar amounts; they should be expressed in numerals ($200, $500,000). The proper form to express millions of dollars is "$200 million".

If expressions such as "average daily traffic" are used often, the expression ADT is acceptable provided that the first usage is spelled out and followed by the abbreviated form in parentheses: "The average daily traffic (ADT) ranges from . . ." This also applies to agencies or other commonly used initials.

In expressing clock time, use lower case letters with periods (10:30 a.m., 2:30 p.m.). The word "o'clock" is not used with this form of abbreviation.

Metric abbreviations are acceptable and should be expressed in lower case (km for kilometre, m for metre, etc.) and always in the singular. Capital letters are used to express volt (V) and watt (W) in tables, but should be spelled out in the text.

DUPLICATION AND OVERLAP

Each chapter should be a discrete, stand-alone unit, complete within itself. It is recognized that this requirement may result in some duplication and overlap among chapters. Repetition, in some cases, tends to reinforce and stress significant factors; however, effectiveness diminishes when detail of a general nature is continually repeated. There is also a danger of contradiction when, for example, a relatively straightforward procedure or technique is described by different writers.

This potential problem can be alleviated by reviewing the outlines of other chapters to identify those elements common to various chapter subject areas. Where commonality exists, reference should be made to the more definitive discussion. If, in the author's judgement, the common subject matter is essential to continuity, the information may be summarized and introduced with a reference statement such as, "As described in Chapter X, an origin-destination survey should be undertaken to provide the data base for . . ." The overriding consideration should be the logical and complete coverage of the topic.

3. FORMAT AND STYLE

The slurry pipeline manual will be reproduced as an 8½ x 11 inch loose leaf manual contained in a three ring binder for ease of updating. It will be reproduced on both sides of the page with each new chapter beginning on a right-hand page. The physical preparation of the master reproducible copy will be the responsibility of each contributing author. To maintain continuity, each author should strive to adhere to the following format in preparing his manuscript.

REPRODUCIBLE MASTER COPY

The manuscript submitted by each author must be ready for direct reproduction "as is". Obvious erasures or typed-over corrections are not acceptable. Copy should not be spliced together with tape or glue as this will result in demarcation lines when reproduced.

Each author should carefully proofread the master copy before submittal. Minor typographical errors may be corrected with correction fluid if care is taken in applying a light coat of the correction fluid and in lining up the type. Typewriter film ribbons should be of high quality to produce sharp, clear impressions.

Only an original typed copy will be accepted. Xerox copy (or equivalent) is not considered adequate for reproduction.

In addition to the typed narrative, each chapter submittal should include a table of contents defining main (first-level) topic headings with page numbers. A separate list of figures and tables with page numbers should also be included. Do not use leaders (. . . . .) between topic headings or titles and page numbers.

Any art work or oversized tables should be photographically reduced (if necessary) and inserted in the appropriate position.

(See the discussions of art work later in this section.)

It should be clearly understood that the quality of the reproducible copy submitted is the responsibility of the contributing author. Excellent technical work can be downgraded and not fully appreciated if it is presented in a careless manner.

PAGE SIZE AND IMAGE AREA

The image area (maximum usable area for copy) is 6½ x 9 inches. Exhibit 3 shows the placement of the image area on the 8½ x 11 inch sheet size with the appropriate margins. The first (right-hand) page of each chapter is slightly different from the continuing pages to allow for the chapter title.

Exhibits 4 and 5 provide full-size reproductions of the image area boundaries for use by the typists as "back-up sheets". In this technique, the back-up sheets are reproduced by xerox or similar equipment. The typist uses the appropriate form as a second sheet behind the typewriter page. The image area (or marginal boundaries) can be seen and will assist in setting the typewriter margins, beginning and ending the page at the proper place, and centering titles and page numbers. Back-up sheets can also be used by technical illustrators to determine the ultimate size of illustrations and tables. (Further detail on preparing illustrations is presented later in this section.)

TYPE SPECIFICATIONS

This discussion details the mechanical typing specifications to be followed in preparing the reproducible manuscript. While it is essential that the typists are aware of these requirements, it is not reasonable to expect manuscript typists to shoulder the responsibility for translating handwritten draft into the proper format without precise instructions from the author. It is usually beneficial to go over the general requirements with the typist in-

volved prior to initiating final preparation. However, the author should prepare his draft copy in the proper format and style with marginal instructions (where necessary) to expedite and facilitate the typing effort.

Although typists will normally proof their typing, only the author can determine if handwritten copy has been correctly translated into typed copy. Authors are urged to proofread and review their manuscript before final submittal.

Spacing

The reproducible master copy should be typed single space on one side of a good grade bond stock. Double spaces should be used between major topic headings designated by capital letters (A, B, C . . .). One and one-half space should be allowed between subtopics designated by numerals or lower case letters (1, 2, a, b). Exhibit 6 is an example of the appropriate spacing.

Type Face

It is recognized that not all authors will have access to the same typewriter equipment. Generally, IBM Selectric (or equivalent) is preferred. With this equipment, which can be rented or leased, the same typeface is available through the purchase (under $40) or rental of the desired interchangeable typeface unit ("ball"). The IBM Selectric typeface "Courier" should be used wherever possible. This is a pica size (10 point) typeface that is highly legible and reproduces well. (This document has been typed in the prescribed typeface.)

Headings and Indentations

Chapter headings will probably be typeset during the production process in large bold type and stripped on to the reproducible copy so that all chapter headings will be distinct and alike. In preparing the manuscript, the chapter title should, however, be

typed in all capital letters and centered on the page in the proper location (See Exhibit 3). Major and subheadings will be typed in upper and lower case and the entire heading will be underlined. A period will follow the heading, and the text will begin on the same line. Exhibit 6 shows the heading format and the indentations to be used for the various levels of headings.

NUMBERING PAGES, TABLES, FIGURES

All pages, tables, and figures within a given chapter will be numbered sequentially in arabic numerals preceded by the chapter number (e.g., Page 6-1 is the first page of Chapter 6, and Table 5-1 will be the first table in Chapter 5). Page numbers will be centered one-half inch from the bottom of the page at the location indicated in Exhibit 3. All tables should be titled. The table number and title appear centered above the table in all capital letters. If the title runs two lines, the second line is centered beneath the first line (See Exhibit 7).

Figure titles appear beneath the illustration (or photograph) and are typed similarly to the table titles (all capitals, centered). All tables and figures should be referenced in the text. In referencing tables and figures, spell out and capitalize ("See Figure 5-2 and Table 5-4").

TABLE FORMAT

Generally, tables are used to present comparative data in a condensed form. They should be as simple as possible so that the reader can easily grasp the meaning of the data. Do not confuse tables and figures. A figure is a graphic depiction, while a table is a columnar presentation of data.

Placement

A table should be located as near as possible to the reference and text discussion which the table supports. For example, a full-

page table should be placed on the page following its reference. If the table is less than a page, if possible it should be placed on the same page with its reference. If there is not enough space available, it should be placed at the top of the following page with the continuing text placed approximately three-quarters of an inch beneath the bottom edge of the table. Do not break a table in order to place it near its text reference. Try to avoid tables that must be placed sideways on the page (along the 9-inch dimension) so that the reader does not have to rotate the book to read the table.

Headings and Columns

Each column should have an appropriate heading including the unit of measure (e.g., "Distance, kilometres", "Cost, Thousands of Dollars"). Do not repeat the unit within the column entry. Headings should be as brief as possible. If the headings run two or more lines, all bottom lines should line up (See Exhibit 7).

The width of the individual columns is normally dictated by the width of the entry and/or the column heading. In tables requiring a number of columns, if the columns are, for example, two-digit numbers, but even the most abbreviated headings require an inch or more of width, it is usually desirable to type the column headings either vertically, as shown in Exhibit 7, or on a slant. Decimal points within a column should fall in a vertical line.

Oversize tables (those that do not fit within the 6½ x 9 inch image area) must be reduced to fit. To be legible, the typewriter face should not be reduced more than 50 percent, preferably no more than 25 percent. Foldout tables will not be accepted.

Ruling

All tables should be boxed; that is, enclosed with both vertical and horizontal outside boundary lines forming a box. Tables

containing three or more columns should have internal vertical rules to separate the several columns. Within the body of the table, horizontal rules are not used.

Footnoting

If the table is abstracted or reproduced in its entirety from another document, the source of the table and/or data should be referenced in a footnote at the bottom of the table outside the box rule. In addition, any explanatory notes needed to clarify column headings or data entries should be designated by a numerical superscript with the explanation at the bottom of the table outside the box rule.

ILLUSTRATIONS

Graphic art used to illustrate or support the text must be clear, concise, and easy to comprehend. Wherever possible, the art should be incorporated on the same page with the text. Illustrations must not exceed the image area. A full page illustration is acceptable, but foldouts (oversize) are unacceptable.

To conform to the limitations of the image area, it may be necessary to reduce original artwork to fit within the page boundaries. When reductions are anticipated, callouts or legends on the original should be of ample size to remain legible after reduction. In other words, typewriter size (pica) lettering should not be used for callouts on original artwork that will require a three- or four-time reduction to fit into the image area. In these cases, the artwork should be prepared and reduced before the typewritten callouts are inserted. Freehand lettering of callouts should not be used; press-on letters or typewritten callouts are preferred, but mechanical lettering (such as Leroy) is acceptable. The final size of the lettering should not exceed 3/16 inch in height nor be less than 1/8 inch.

Another primary consideration in preparing illustrations is simplicity. It serves no useful purpose to clutter illustrations with too much information that may confuse the reader or require intense study to determine the meaning of the information presented.

Graphs

A line graph is primarily used to show two or more related variables. The independent variable normally appears along the horizontal (abscissa or x) axis and the dependent along the vertical (ordinate or y) axis. Fine line grids should be avoided. Increments or multiples of 1, 2, 5, or 10 should be used. If desired, short dashes on the scale line may be used to indicate the smaller increments with grid lines limited to the larger increments.

Label the ordinate and abscissa outside the graph. The label should include the parameter plotted and the unit of measure (e.g., "Time, Seconds"). All callouts should read horizontally except for the ordinate callout, which should read vertically from the bottom. In graphs with more than one curve, identify each curve by a callout or by line coding (dashed, dotted, solid) as explained in a boxed legend within the body of the graph. Exhibit 8 presents typical line graph formats.

A bar graph can be used to show the values of discrete variables by the length of the bar. Grid lines are not essential, but several grid lines can be used to permit easy reading. Callouts on bar graphs are governed by the same format as for line graphs.

Line Drawings

Line drawings to illustrate, for example, geometric configurations should be prepared on a good grade vellum or linen and inked with india ink. Pencil or ballpoint pen drawings reproduce poorly and will downgrade the appearance of the book and are therefore unacceptable. Standard symbols and abbreviations may be used if space is limited.

Photographs

Photographs are costly to reproduce and become obsolete rapidly. Consequently, photographs should be limited, if used at all.

If the use of a photograph cannot be avoided, a black and white continuous tone print should be furnished separately (not mounted on the reproducible copy). The figure number and title should be typed on the reproducible copy in its appropriate position. Colour slides and prints are not acceptable. Using a tissue overlay taped to the back of the print, indicate that portion of the print to be used (crop marks) and the amount of reduction desired. On the back, tape a notation keying the photograph to its page location and to its figure number and title.

EQUATIONS

Most equations used in this type of engineering manual have super- or subscripts and are often expressed as fractions. Consequently, in a single-spaced text, it is seldom desirable to write an equation within a text line. Equations should be centered on a separate line. Where appropriate, the definition of symbols should immediately follow as shown in the example below:

The systematic methods for estimating the interchange of trips between any two zones can all be represented as follows:

$$T_{ij} = T_i \cdot P(T_j)$$

where

T_{ij} = Calculated trips from zone i to zone j

T_i = Total trips originating at zone i

$P(T_j)$ = Probability measure that trips will be attracted to zone j

Note that no punctuation is used, that the definitions are indented five spaces, and that the equal signs are lined up.

In typing fractions, the bar appears in the center of the vertical line space and quantities above and below the line are centered horizontally.

$$s^2 = \frac{\Sigma f_i (x_i)^2 - \frac{1}{n}(\Sigma f_i x_i)^2}{n-1}$$

Long equations may be broken or divided only at a +, -, or = sign. The + or - sign is carried over to start the second run-over line. A series of equations should be aligned by the equal sign.

It is recommended that the typist handroll the carriage for superscripts or subscripts rather than using an extra half-line space. The subscript should precede the superscript (T_j^2).

Equations need not be numbered unless reference will be made to them in the text. In cases where one or more of a series of equations are discussed in the narrative, type the equation number in parentheses flush right, even with the equation.

$$T_{ij} = T_i \cdot P(T_j) \qquad (1)$$

Exhibit 1
EXAMPLE OF NARRATIVE OUTLINE STRUCTURE
(Reduced from 8 1/2" x 11" Page)

4. VOLUME STUDIES AND CHARACTERISTICS

A. Purpose. Traffic volume studies are made to obtain factual data concerning the movement of vehicles and/or persons at selected points on the street or highway system. Volume data are expressed in relation to time --the base being determined by the type of information desired and the application in which it is to be used.

1. Annual Traffic. Data on the annual traffic in vehicles per year is used for:

   a. Determining annual travel in a geographic area.

   b. Estimating expected highway user revenue.

   c. Computing accident rates.

   d. Indicating trends in volume, especially on toll facilities.

3. Hourly Traffic. Data on hourly traffic in vehicles per hour is used for:

   a. Determining length and magnitude of peak periods.

   b. Evaluating capacity deficiencies.

   c. Establishing traffic controls--volume is usually among the warrants for the:

      (1) Installation of signs, signals, and markings.

      (2) Designation of through streets, one-way streets, unbalanced flow, and traffic routing.

      (3) Prohibition of parking, stopping, and turning.

   d. Geometric design or redesign of streets and intersections.

5. Density of Traffic. Traffic density in vehicles per mile is obtained by dividing the hourly volume by the average speed. Density may be a better measure of street service than volume since it continues to increase as congestion increases. Volume, on the other hand, reaches a maximum under moderate congestion and then decreases with greater congestion. When a complete blockage occurs, density is at its maximum and volume is zero. The generalized relationship between volume, speed, and density is shown in Figures 4-1 and 8-2.

B. Volume Studies. The type of data collected in a specific volume study depends upon the application in which the information will be used.

4-1

Exhibit 2

REFERENCE AND BIBLIOGRAPHY FORMAT

- References are cited in text and numbered sequentially
- Bibliography is an alphabetical listing of related sources not cited in text
- Descriptive information on the resource document (reference or bibliographic entry) is presented in the following order (if available)

  Author (last name first), title (an article within a document is enclosed in quotation marks followed by name of document underlined), publisher, where published, date of publication, page numbers of relevant material

EXAMPLES

REFERENCES

1. Federal Highway Administration. U.S. Department of Transportation. Manual on Uniform Traffic Control Devices for Streets and Highways. Washington, D.C.: U.S. Government Printing Office, 1971. pp. 215-257.
2. Peat, Marwick, Livingston and Co., SIGOP: Traffic Signal Optimization Programs. Springfield, VA.: Clearinghouse for Federal Scientific and Technical Information, 1966.
3. Kay, Jack L., Computer Signal Systems--State of the Art. 1970 ITE Western Section Annual Meeting, San Francisco, CA. Paper 10A, 1970.
4. Holroyd, Joyce and J. A. Hillier, "Area Traffic Control in Glasgow: A Summary of Results from Four Control Schemes," Traffic Engineering and Control. vol. 11, No. 5, Sept. 1969. pp. 220-223.
5. Peat, Marwick, Livingston and Co., Motorist Aid System for Rural Freeways. (Report to the State of Illinois.) San Francisco, CA, July 1968.
6. Duff, J. T., "Accomplishments in Freeway Operations Outside the United States," Highway Research Record 368: Accomplishments in Freeway Operations. Washington, D.C.: Highway Research Board, 1971. pp. 9-25.

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Douglas, Marvin, et al., Communication System Handbook for State Highway Departments. Federal Highway Administration, Department of Transportation, Washington, D.C., April 1973.

Duff, J. T., "Accomplishments in Freeway Operations Outside the United States," Highway Research Record 368. Highway Research Board, Washington, D.C., 1971.

Eagle Signal Corporation, Concept and Design of Motorist-Aid Systems. Gamewell, Davenport, IA, 1975.

Federal Highway Administration, Highway Communications Systems, Technology and Design: Federal Highway Administration Position Paper. Department of Transportation, Washington D.C., Sept. 1973.

Federal Highway Administration, "Motorist Aid Systems," Federal Register. vol. 40:10, Jan. 15, 1975.

Exhibit 3

PAGE DIMENSIONS AND IMAGE AREA

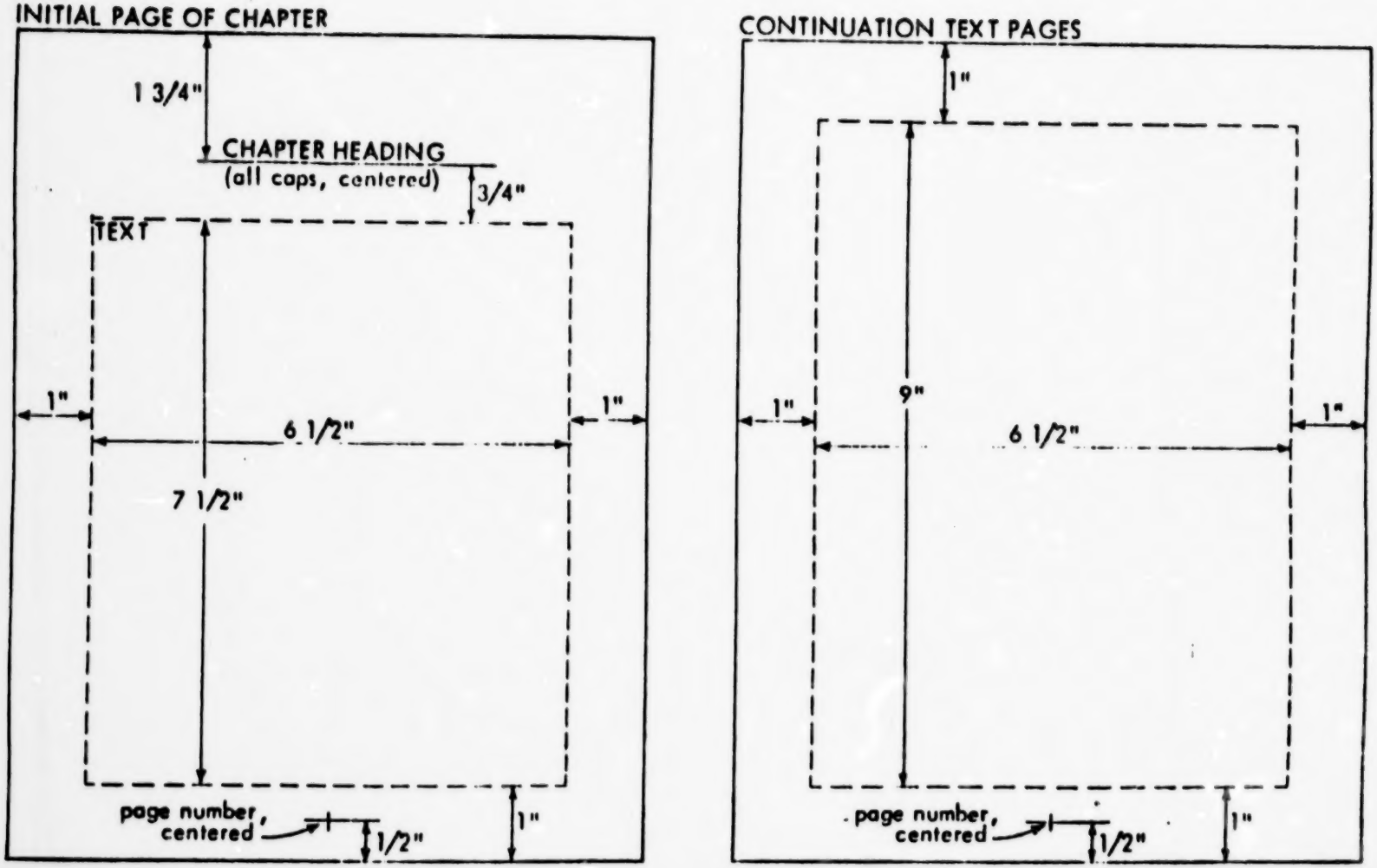


Exhibit 4

BACK-UP SHEET FOR FIRST PAGE OF CHAPTER

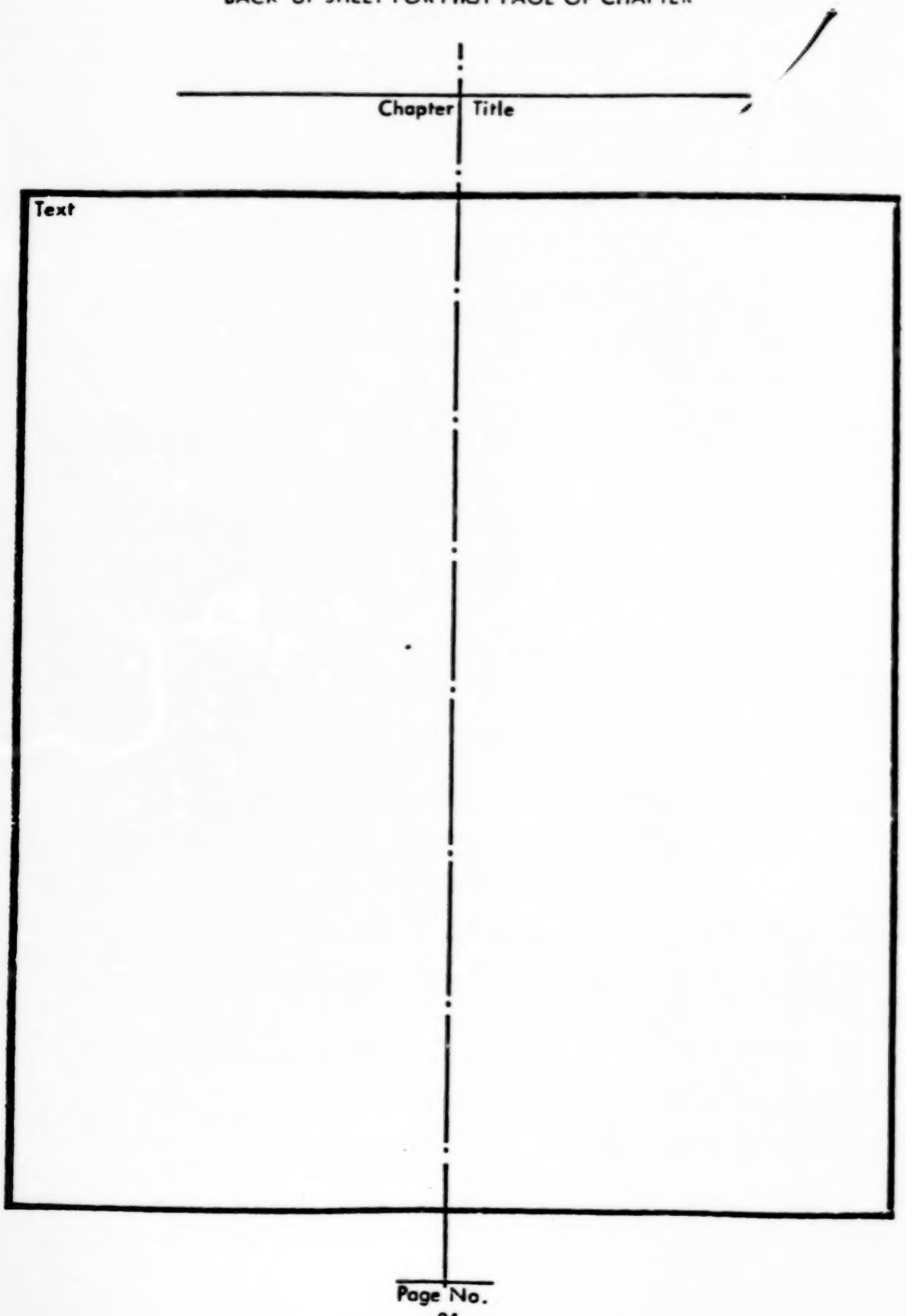


Exhibit 3

BACK-UP SHEET FOR CONTINUATION PAGE

Text

Exhibit 6

TYPE SPACING AND INDENTATION

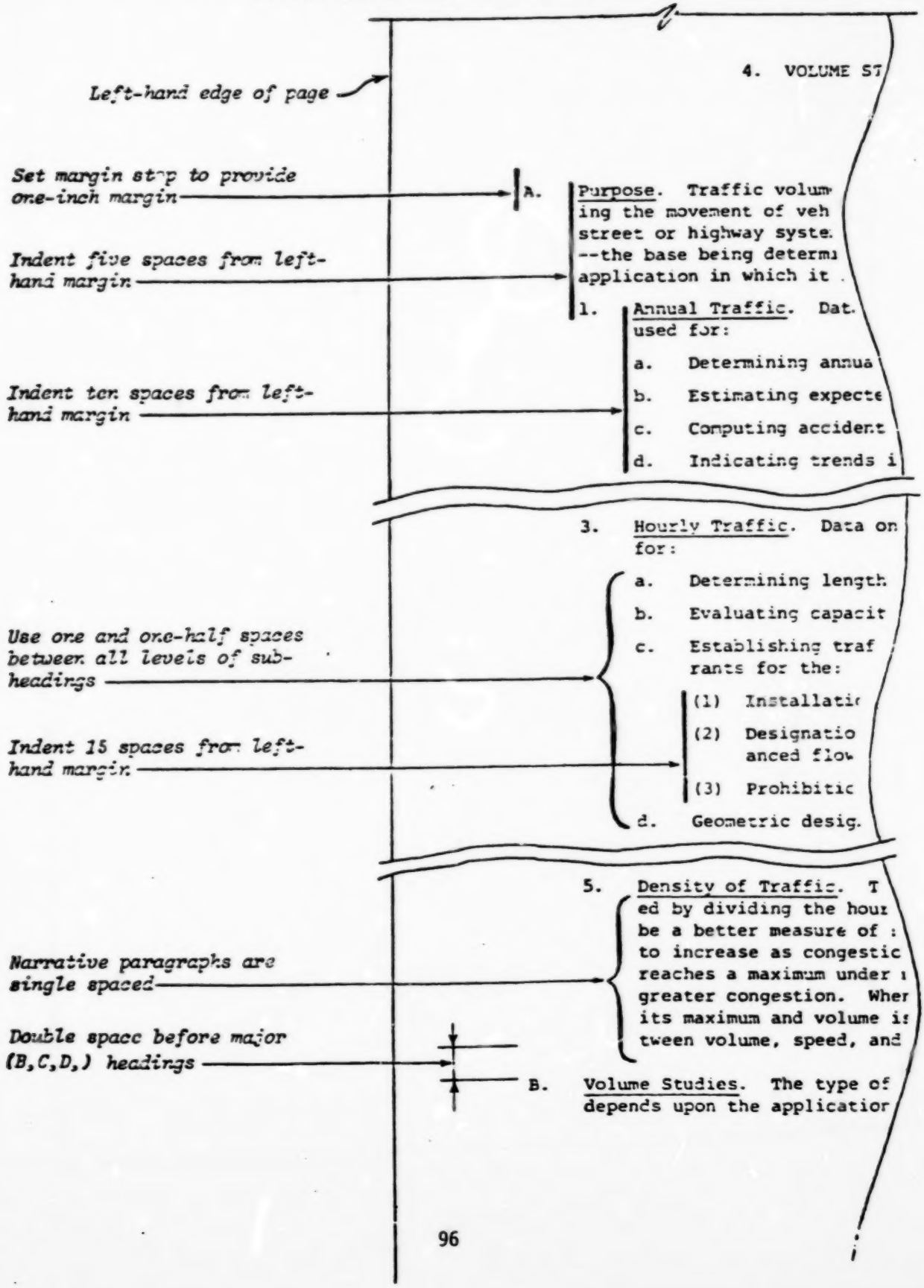

4. VOLUME ST
Left-hand edge of page
Set margin stop to provide one-inch margin
A. Purpose. Traffic volum
ing the movement of veh
street or highway syste
--the base being determi
application in which it
Indent five spaces from left-hand margin
1. Annual Traffic. Dat
used for:
a. Determining annua
Indent ten spaces from left-hand margin
b. Estimating expecte
c. Computing accident
d. Indicating trends i
3. Hourly Traffic. Data on
for:
a. Determining length
Use one and one-half spaces between all levels of sub-headings
b. Evaluating capacit
c. Establishing traf
rants for the:
Indent 15 spaces from left-hand margin
(1) Installatic
(2) Designatio
anced flow
(3) Prohibitic
d. Geometric desig
5. Density of Traffic. T
ed by dividing the hour
Narrative paragraphs are single spaced
be a better measure of
to increase as congestic
reaches a maximum under
greater congestion. Wher
its maximum and volume is
tween volume, speed, and
Double space before major (B,C,D,) headings
B. Volume Studies. The type of
depends upon the applicatior

Exhibit 7

SAMPLE TABLE FORMATS

Table 5-1. SYSTEM USAGE CHARACTERISTICS

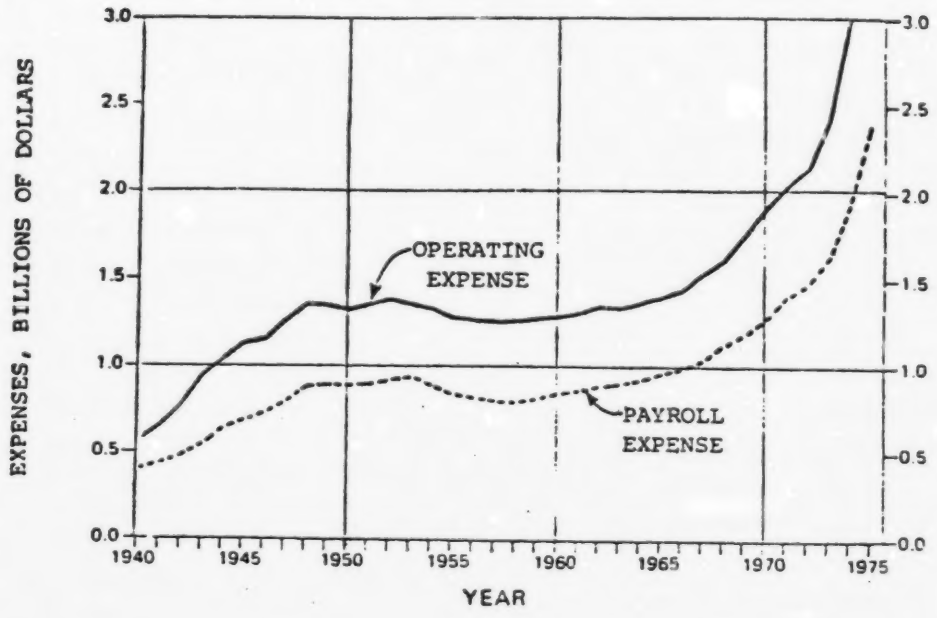
Motorist Aid System (Type Facility)	Length Mi (Km)[1]	No. Units	Reported Calls/Day	Calculated Calls/MVM (Calls/MVKm)	Calculated Calls/Mile /Day (Calls/Km/Day)
Coded Systems					
Maryland, I-495 (Urban, Suburban)	42 (67)	216	50.0	18.44 (11.47)	1.190 (0.746)
Texas, I-45 (Urban)	11 (18)	145	5.6	6.67 (4.15)	0.509 (0.311)
Florida, I-75 (Rural)	43 (69)	164	20.0	22.81 (14.18)	0.465 (0.290)
Massachusetts, I-495 (Rural-Suburban)	62 (100)	248	35.0	17.32 (10.76)	0.565 (0.350)
Massachusetts, I-195 (Rural-Suburban)	26 (42)	102	14.0	14.76 (9.17)	0.538 (0.333)
Illinois, I-55/I-70/I-270 (Rural)	40 (64)	165	12.0	–	0.30 (0.186)
Voice Systems (Hardwired)					
Michigan, I-94 (Rural)	30 (48)	62	4.7	11.09 (6.89)	0.155 (0.098)
New York, I-87 (Rural)	178 (285)	712	30.0	13.88 (8.63)	0.169 (0.105)
Illinois, I-80 (Rural)	138 (220)	302	28.9	10.47 (6.51)	0.209 (0.131)
*California, LA Freeways (Urban)	310 (499)	2103	764.0	15.28 (9.50)	2.465 (1.531)
Delaware, I-95 (Rural)	11 (18)	53	10.5	31.9 (19.78)	0.955 (0.593)
Oklahoma, Turner Turnpike (Rural)	87 (139)	16	4.7	7.50 (4.66)	0.05 (0.034)
Pennsylvania, I-80 (Rural)	101 (163)	362	11.0	7.77 (4.83)	0.109 (0.068)
Voice Systems (Radio)					
Florida, I-95/I-195 (Urban)	33 (53)	90	35.0	6.87 (6.47)	1.06 (0.660)
Connecticut, I-84/I-91 (Urban, Suburban)	42 (67)	178	40.0	–	0.952 (0.597)

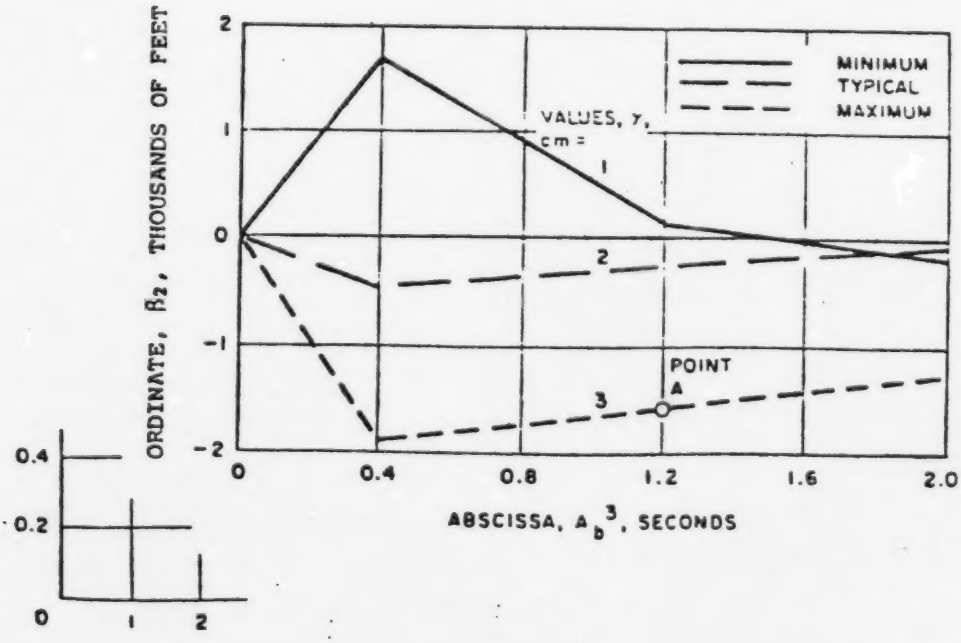
Source: Ref. 4
Note: The metric measure will be used followed by the English equivalent.

LOCATION*	NUMBER OF SIGNALIZED INTERSECTIONS		CONTRACT SCOPE OF TASKS														
	Initial	Ultimate	Analysis of System Requirements	Definition of Alternatives	Evaluation & Selection of Alternatives	Development of Recommended Program	System Design	Detailed Specifications	Estimates	Plans	Prequalification of Bidders	Bid Evaluation & Selection	Supervision of Installation	Documentation	Training	Computer Software Design	Supervision of Testing & Evaluation
City of Baltimore, Md.	900	1200	●	●	●	◐	●	●	●	●	●	●	◐	●	●	●	●
City of Phoenix, Ariz.	260	750	●	●	●	◐	●	◐	◐	●	◐	◐	◐	●	●	●	◐
City of Tucson, Ariz.	130	300	◐	◐	◐	◐	◑	◑	◐	●	◐	◐	◐	◐	◑		

Exhibit 8

SAMPLE GRAPHS





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POOR

QUALITY

ORIGINAL